TRANSACTIONS

OF THE

ROYAL SOCIETY OF EDINBURGH.

VOL. III.

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THIRD VOLUME.

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TRANS-

HISTORY

OF

THE SOCIETY.

1789.
Jan. 5.
On the cause of heat in chemical mixtures.

PHYSICAL Class. A paper on the Cause of Heat in Chemical mixtures, formerly read in the Philosophical Society, was communicated by Dr GARDNER. Mr ROBERT KERR read an Essay on the Origin of the Heat and Light in Deflagration.

Jan. 26.
General Meeting.

A GENERAL Meeting of the Royal Society was held for the election of Members, [See the List in the Appendix to the History of the Society, Vol. II.]

Feb. 2.
Biographical account of Dr Wilson.

Phys. Cl. A BIOGRAPHICAL account of the late Dr WILSON, Professor of Astronomy in the University of Glasgow, was read;

1789. read; communicated by his ſon Mr PATRICK WILSON, the preſent Profeſſor of Aſtronomy in that Univerſity.

March 2. Mr Playfair on the aſtronomy of the Brahmins.

Phyſ. Cl. Mr Profeſſor PLAYFAIR read a paper on the Aſtronomy of the Brahmins. [See Vol. II. No. XIII. *Phyſ. Cl.*]

March 16. Biographical account of Sir William Dick.

Literary Claſs. Dr DUNCAN read a Biographical Account of Sir WILLIAM DICK of Preſtonfield, Bart. [See the Appendix to the Hiſtory of the Society, Vol. II. p. 58.]

April 6. Account of the *oldenlandia umbellata.*

Phyſ. Cl. Dr ANDERSON read a communication from Dr JAMES ANDERSON of Madras, containing an Account of the *Oldenlandia Umbellata*, the Plant uſed for giving a red Dye to Cotton in the Eaſt Indies.

April 20. Account of the iſland and caſtle of Lochurr.

Lit. Cl. Dr GREGORY read an Account of the Iſland and Caſtle of Lochurr, in the ſtewartry of Kirkudbright; communicated by Mr RIDDELL of Friars Carſe, and tranſmitted by Lord HAILES.

ACCORDING to this account, Lochurr is ſituated in the midſt of a wild country on the eaſtern border of Galloway, about ten miles eaſt of the town of New Galloway. Upon the eaſt ſide of the loch are two ſmall iſlands, joined to the ſhore by a cauſeway of large ſtones, which is at preſent pretty deep under the ſurface of the water. The gentleman from whom Mr RIDDELL received this account, was obliged to wade along this cauſeway up to the middle, in order to reach the iſlands, and to proceed with a great deal of caution, as the water on each ſide was about 16 feet deep. The neareſt and ſmalleſt of theſe iſlands he found to be covered with willows and long graſs, and to be about 70 feet long by 36 broad. About 70 feet farther, is the largeſt of the iſlands, about 200 feet long and 72 broad, and ſurrounded by a wall of ſtones without mortar, ſix feet thick, and in ſome places five feet high. On

On each ſide of the entrance from the cauſeway, the wall is formed into a circular tower, and within it are three or four foundations of houſes. 1789.

This little iſland is inhabited by adders, and by the large Scotch eagle, called the Earn.

On leaving it, our traveller proceeded along the ſhore, about a mile toward the ſouth, in order to viſit another iſland, called the White Iſland. The White Iſland is in fact ſurrounded by the loch only on three ſides. On the fourth, it is contiguous to a peat-moſs of the kind called a flow-moſs, and is ſeparated from it by a ditch about 36 feet wide and 300 long, which ditch is ſtrengthened by a ſtrong breaſt-work on the ſide toward the iſland. You enter by what ſeems to have been the ancient gate, where the ditch is filled up. The iſland is about 552 feet long, and nearly of the ſame breadth. It appears to have been a Roman fortification, and in all probability is what Cambden calls the *Cardea* of Antoninus. There is a tradition here, that a number of Roman ſoldiers were ſtarved to death in this iſland.

On the eaſt ſide of it, there are two mounts of about 38 feet in diameter each, and at ſome diſtance from one another. On the north ſide, the foundation of ſeveral buildings are ſtill to be ſeen.

The water of Urr runs out of the loch on the weſt ſide of this iſland.

It is to be remarked, that the names of the places in this neighbourhood are Gaelic, which language was ſpoken in the remote parts of Galloway ſo late as 1671 and 1672.

April 20. Mr Dalzel on poetry.

Mr Profeſſor Dalzel alſo read an Eſſay on Poetry, conſidered as an Imitative Art.

June 15. Dr Anderſon on perſonal pronouns.

Lit. Cl. Dr Anderson read a paper, containing Obſervations on the Perſonal Pronouns.

1789.
June 15.
Defcription of a ftone found at Coilsfield.

A DESCRIPTION and Drawing of a Stone found at Coilsfield in Ayrfhire, was communicated by Colonel MONTGOMERY of Coilsfield.

THE ftone here referred to was found in digging a gravel-pit at Coilsfield, and under it an urn, of earthen ware, full of bones, not calcined, but broken down into fmall fragments, fo that they refembled thofe found in the rock of Gibraltar. The ftone is reprefented of an irregular figure, about five feet in length and two and a half in breadth. On the furface of it are traced, near one end, fix concentric circles, at equal diftances from one another; the diameter of the largeft is about eighteen inches. The other lines traced on the ftone are fo very irregular, that no conjecture can be formed of what they were intended to exprefs.

June 29.
General Meeting.

A GENERAL Meeting of the Royal Society was held for the election of Members. [See Appendix to the Hiftory of the Society, Vol. II.]

July 3.
M. Monnet on the formation of minerals.

Phyf. Cl. Dr WALKER read an Effay on the Formation of Minerals by M. MONNET.

July 20.
Dr Anderfon on the laws refpecting debtors.

Lit. Cl. Dr ANDERSON read a paper, entitled, Hints for the Improvement of the Laws in Scotland refpecting Debtors.

Nov. 2.
Dr Guthrie on the climate of Ruffia.

Phyf. Cl. An Effay on the Climate of Ruffia by Dr MATTHEW GUTHRIE of St Peterfburg, was communicated. [See Vol. II. No. XV. *Phyf. Cl.*]

Nov. 30.
General Meeting.

A GENERAL Meeting of the Royal Society was held for the election of Office bearers. [See Appendix to the Hiftory of the Society, Vol. II.]

Phyf.

Phyſ. Cl. Dr WALKER communicated ſome papers from Dr FRANCIS BUCHANAN of Leny. They contained obſervations on the Caves of Elephanta, a Deſcription of two Water-ſpouts, and of a Luminous Appearance of the Sea. 1789. Dec. 7. On the caves of Elephanta, &c.

Lit. Cl. A COMMUNICATION was read from Dr WILLIAM BLANE in India, being Obſervations on the Origin of the Numerical Characters, commonly called Arabic. The object of this paper was to prove, that theſe Characters are of Indian origin, agreeably to the opinion now generally received concerning them. Dec. 21. Dr Blane on the Arabic characters.

Mr HUME alſo read a Biographical Account of the late Sir THOMAS MILLER of Glenlee, Bart. [See Appendix to the Hiſtory of the Society, Vol. II. p. 63.] Biographical Account of Sir Thomas Miller.

Phyſ. Cl. Dr HUTTON read a paper entitled, Obſervations on Granite. The paper is publiſhed in this volume. [No. II. *Phyſ. Cl.*] 1790. Jan. 4. Dr Hutton on granite.

Sir JAMES HALL alſo read the firſt part of a paper, entitled, Obſervations on the Formation of Granite. Sir James Hall on granite.

Lit. Cl. Mr Profeſſor DALZEL read a paper, containing Obſervations on the Pathetic in Poetry, and on the Union of the Pathetic and Sublime. Jan. 18. Mr Dalzel on poetry.

A GENERAL Meeting was held for the Election of Members. [See Appendix to the Hiſtory of the Society.] Jan. 25. General Meeting.

Phyſ. Cl. JOHN CLERK, Eſq; of Elden, read the firſt part of a paper, entitled, A Scheme for weighing up Ships ſunk under Water. Feb. 1. Mr Clerk on weighing up ſhips.

1790. Feb. 15. Mr Hunter on the Latin compound perfect tense.

Lit. Cl. Mr DALZEL read a paper on the Latin compound perfect Tenſe, by Mr HUNTER, Profeſſor of Humanity in the Univerſity of St Andrew's.

March 1. Sir James Hall on granite.

Phyſ. Cl. Sir JAMES HALL communicated the remainder of his paper, *viz.* Obſervations on the Formation of Granite.

Sir JAMES HALL declined putting the two papers above mentioned into the hands of the Committee for publication, as they refer to Dr HUTTON's Theory, which the author has not yet explained ſo fully as he intends, but which he is preparing to give, accompanied by that variety of proofs and illuſtrations, which the profound reflection, and extenſive obſervation of many years have furniſhed him with. The following abſtract of them, therefore, is all that Sir JAMES thinks it proper to communicate at preſent.

THE firſt paper was ſuggeſted to him by a mineralogical excurſion which he made in 1788, in company with the Honourable T. DOUGLAS, among the mountains of Galloway, in order to examine into the curious facts reſpecting the junction of the granite and the ſchiſtus, which were firſt obſerved by Dr HUTTON, as related in his paper mentioned above, and ſoon after communicated by him to Sir JAMES HALL. Sir JAMES accordingly having met with the line of ſeparation of theſe two bodies, continued to follow it till he made the entire circuit of a conſiderable tract of granite country, which reaches from the banks of Loch Ken, where the junction is moſt diſtinctly ſeen, to the valley of Palnure, and occupies a mountainous ſpace of about eleven miles by ſeven; and in all this extent, he found, that wherever the junction of the granite with the ſchiſtus was viſible, veins of the former, from fifty yards, to the tenth of an inch in width, were to be ſeen running into the latter, and pervading it in all directions, ſo as to put it beyond all doubt, that the granite of theſe veins, and conſequently of the great body itſelf, which he obſerved forming with the

2 veins

veins one connected and uninterrupted mafs, muft have flowed in a foft or liquid ftate into its prefent pofition.

In giving an account of thefe obfervations, Sir James Hall was led, by finding it impoffible for him to exprefs his ideas clearly on the fubject, to enter at confiderable length into a difcuffion of the terms of mineralogy, the imperfection of the language of that fcience, and the principles on which a lefs ambiguous nomenclature might be formed. He particularly pointed out, as the bafis of fuch a nomenclature, the grand divifion which nature has made in the mineral kingdom, into ftratified and unftratified bodies, the former comprehending both the primary and fecondary ftrata, the latter comprehending granite, porphery, bafaltes, trap or whinftone, and lava.

He next ftated the argument which the facts concerning granite that have been referred to above, afford in fupport of Dr Hutton's Theory of the Earth. He remarked alfo the great number of facts which he had met with in Scotland, and in the volcanic countries of Italy, that were connected and explained by that theory, and by no other; concluding on the whole, that there was fcarcely any fyftem in phyfics eftablifhed on more folid principles, and that the publication of it was likely to form a very important epoch in the hiftory of this branch of philofophy.

To a theory, however, which embraces fo great a variety of objects, fome difficulties muft be expected to occur; and this is the more likely to happen, that though the agents employed in it be fuch as we are well acquainted with, yet they are introduced as acting in circumftances very different from thofe in which we ufually fee them act.

Of thefe difficulties the moft confiderable appeared to Sir James Hall to be the following: In granites which contain quartz and felt-fpar, it frequently occurs, that the felt-fpar is feen with the form of its cryftals diftinctly defined, whilft the quartz is a confufed and irregular mafs, being almoft univer-

ſally molded upon the cryſtals of felt-ſpar. Now, were it true, that all granite is formed by fuſion, the very contrary, it would ſeem, ought always to take place, as felt-ſpar is very eaſily melted, and quartz reſiſts the greateſt efforts of heat that have hitherto been applied to it.

This difficulty is obviated thus: It is well known, that when quartz and felt-ſpar are pounded and mixed together, the mixture may, without difficulty, be melted and run into a kind of glaſs, the felt-ſpar ſerving as a flux to the quartz. The ſame fact may be ſtated in another way, by conſidering the felt-ſpar, when melted, as a fluid in which, as in a menſtruum, the quartz is diſſolved; and in this view, we may expect, by analogy, that phenomena, ſimilar to thoſe of the ſolution of ſalt in water, ſhould take place. Now, it is certain, that when exceſſive cold is applied to ſalt water, the water is frozen to the excluſion of the ſalt, the ice obtained yielding freſh water when melted, and the ſalt, when the experiment is puſhed to the utmoſt, ſeparating from it in the form of ſand. Why ſhould not the ſame thing happen in the ſolution of quartz in liquid felt-ſpar, when the maſs is allowed to cool below the point of congelation of the menſtruum? The felt-ſpar may cryſtalize ſeparately from the quartz, as we have ſeen pure ice formed ſeparately from the ſalt; in both caſes, the *congelation of the ſolvent* being *ſimultaneous* to that of the diſſolved ſubſtance. Hence the cryſtals may mutually interfere with each other's forms, and we may as naturally expect to ſee quartz molded on cryſtals of felt-ſpar as the reverſe.

In anſwer to an objection which might be urged againſt this reaſoning, *viz.* that the reſult of the fuſion of granite is a glaſs in which no cryſtalization can be ſeen, an accidental experiment was produced, which had happened at one of the Leith Glaſs-houſes a few weeks previous to the reading of this paper. A quantity of common green glaſs having been allowed, in a great maſs, to cool gradually and very ſlowly, it was found to have loſt all the proper-

ties of glaſs, being opaque, white, very hard and refractory, and wholly compoſed of a ſet of cryſtals, which ſhot into ſome cavities in a determined form. When a piece of this ſubſtance was melted by the violent heat of a blowpipe, and was allowed to cool inſtantly, it recovered all the properties of glaſs. We may conclude from this example, that if the glaſs produced by the fuſion of granite had been allowed to cool with ſufficient ſlowneſs, it might have cryſtalized, producing a granite ſimilar to that which was originally melted.

THE ſame principle ſeems to point out the theory of all kinds of granite, and ſhows their connection with one another, and with all the other unſtratified bodies. If quartz, felt-ſpar, ſchorl, mica, garnet, *&c.* happen to be melted together, the moſt fuſible ſubſtance of them all may be conſidered as the menſtruum in which all the reſt are diſſolved, and we may ſuppoſe, that theſe various diſſolved ſubſtances may differ amongſt themſelves in their properties of ſolution, as ſalts differ from one another; ſo that ſome of them may be more ſoluble in the menſtruum when very much heated, than when it is comparatively cold, and others may be as ſoluble in it, when little warmer than its point of congelation, as when raiſed to a much higher temperature. If then we ſay, for example, that the congealing point of the ſolvent is 1000 degrees of FAHRENHEIT, and if the ſolution is at the temperature of 2000, we may conceive one portion of the matters diſſolved, as held by the ſimple diſſolving power of the menſtruum, and another portion as held by means of its elevated temperature. When therefore a maſs of this kind is allowed to cool very ſlowly, as we may ſuppoſe muſt be the caſe with liquid granite in the bowels of the earth, thoſe ſubſtances, held in ſolution by the heat of the ſolvent, will firſt ſeparate, and being formed in a liquid, will aſſume their cryſtaline forms with perfect regularity; whereas thoſe ſubſtances which were held by the menſtruum ſimply as a fluid, will not ſeparate till the congelation of the ſolvent itſelf

takes place, when the cryſtals of the various ſubſtances will intermix and confound the regularity of form which each would have aſſumed if left to itſelf. In this manner, one of the moſt common kinds of granite will be produced, conſiſting of perfect cryſtals of ſchorl, mica or garnet, incloſed in a confuſed maſs of felt-ſpar, quartz and ſchorl.

If the firſt ſtage of cooling is performed in the bowels of the earth, and if the ſolution, while ſtill liquid, is by ſome effort forced upwards, and erupted into the open air in the form of a lava, which being ſpread thin upon the ſurface, and expoſed to the air, would loſe its heat ſuddenly, the cryſtals of ſchorl and of mica, originally held by the heat of the menſtruum, will be of a large ſize, having been produced in the liquid when in a great maſs, and when its heat of courſe eſcaped very ſlowly, there will be embodied in a maſs formed of very ſmall cryſtals, ſince they have been formed with great rapidity. This in fact is the deſcription of one of the moſt common lavas, which conſiſts of large and perfect cryſtals of ſchorl, embodied in a maſs whoſe fracture is dull and rough, and which, when examined with a microſcope, is found to conſiſt of a congeries of minute cryſtals.

Thus, all the varieties among unſtratified ſubſtances may be accounted for by the different circumſtances in which each of them paſſed from a liquid to a ſolid ſtate.

1790. March 1. Mr Clerk on weighing up ſhips.

Mr Clerk read the ſecond part of his Scheme for weighing up Ships ſunk under Water. [*Vide ſupra*, Feb. 1.]

Mr Clerk not having finiſhed the drawings neceſſary for the illuſtration of this paper, did not put it into the hands of the Committee for publication ; which, however, he has undertaken to do, before another volume of theſe Tranſactions can appear.

Lit.

1790. March 15. Dr Anderſon on *dunes*.

Lit. Cl. Dr ANDERSON read a paper, entitled, Conjectures on the original Uſes of thoſe circular Buildings called *Dunes* in the northern part of Scotland.

April 5. Dr Rutherford's improvement of the thermometer.

Phyſ. Cl. Dr RUTHERFORD read a Deſcription of an Improvement made in the conſtruction of the Thermometer, by JOHN RUTHERFORD, M. D. [See No. XII. of this volume, *Phyſ. Cl.*]

June 21. Dr Anderſon on *dunes*.

Lit. Cl. Dr ANDERSON read an abſtract of his paper on *Dunes*.

June 28. General Meeting.

A GENERAL Meeting was held for the election of Members. [See the Appendix to the Hiſtory of the Society.]

July 5. Mr Kerr on an animal ignotum.

Phyſ. Cl. Mr KERR read a Deſcription of an Animal Ignotum in the Muſeum of the Univerſity of Edinburgh.

Aug. 2. Dr Hutton on the theory of rain.

Phyſ. Cl. Dr HUTTON read Obſervations on the Theory of Rain, being an addition to the papers on that ſubject in the firſt volume of the Tranſactions of this Society, No. II. *Phyſ. Cl.* Theſe obſervations are ſince publiſhed by Dr HUTTON in a ſeparate work, *viz. Diſſertations on different Subjects in Natural Philoſophy*, Edin. 1792, and are contained in the third diſſertation of the firſt part.

Mr Howiſon's account of Prince of Wales iſland.

AT this meeting, there was alſo read an Account of Prince of Wales Iſland, given by Mr JAMES HOWISON, one of the ſurgeons of the new ſettlement in that iſland, communicated by Sir JOHN DALRYMPLE.

THE following are ſome of the moſt remarkable particulars contained in this account.

THIS iſland, which is deſcribed in the charts under the name of *Pulo Penany*, is ſituated in the entrance of the Straits of Malacca, in 100 degrees of eaſt longitude and in 5 degrees of north latitude. It is about ſeven leagues in length and three in breadth.

breadth. Its northern extremity runs nearly parallel with the main land, at a diſtance of about two miles, by which a fine channel is formed, where the greateſt fleets might ride in perfect ſafety, the height of the ſurrounding mountains acting as a barrier againſt the force of the prevailing winds.

THE climate of this iſland, conſidering its vicinity to the equator, is remarkably mild. Eighty degrees is about the mean height of the thermometer at noon, which, during the night, is ſeldom above ſeventy.

ITS healthfulneſs is certainly not ſurpaſſed by that of any European ſettlement on the coaſt. Out of a garriſon of three hundred troops, (natives of Hindoſtan), not one has died for theſe laſt fourteen months; a ſingular fact to be experienced by a new ſettlement in an uncleared country. This great ſalubrity is perhaps the effect of a conſtant ventilation, ſupported by almoſt continued but gentle breezes, added to the dryneſs of the ſoil, the uniform but gradual elevation from the ſea to the foot of the hills preventing thoſe ſtagnations of water which, in tropical latitudes, are ſo highly prejudicial to the health of man.

A RIDGE of beautiful mountains, deeply indented with valleys, and covered with evergreens, divides the iſland longitudinally. Innumerable rivulets receive their origin from theſe mountains, and are remarkable for the tranſparency and coolneſs of their waters.

THE ſoil, which is light and ſandy near the ſea, gradually changes to a rich clay as it approaches to the high lands. There the ſugar-cane grows with the utmoſt luxuriance, and the moſt plentiful crops of rice are every where produced. Our gardens have already furniſhed us with cabbages and potatoes; and when our induſtry ſhall have reached the tops of the mountains, it will be no ſurpriſe to ſee in our plantations moſt of the productions of Europe in their utmoſt perfection.

IN

In decorating the landſcapes of this little iſland, nature has has been peculiarly laviſh. An aſſemblage of flowering trees and ſhrubs in perpetual bloſſom, and endleſs in the variety of their ſpecies, form the firſt ſhade. Theſe are overtopped by foreſt trees of an immenſe height, which ſpread their vaſt branches on every ſide, and are covered with the richeſt foliage. Here ſtrangers feel with rapture the effect of the breezes, which, from whatſoever quarter they blow, are ſtrongly impregnated with the fragrance of the groves.

The original animal productions of this iſland are very limited. Of quadrupeds, the wild hog, deer and ſquirrel, nearly comprehend the whole; but the abſence of the tiger and leopard, whoſe numbers and ferocity almoſt render the oppoſite ſhores uninhabitable, amply compenſates for this deficiency.

The flying fox and ſquirrel are natives of this iſland; the former a non-deſcript, and a great natural curioſity.

Of birds we have alſo but few, and only one which is remarkable for the melody of its notes.

The crow and ſparrow, the never-failing attendants on population, have but lately made their appearance. They are now, however, rapidly increaſing and multiplying. All the domeſtic animals arrive here at great perfection.

The ſea which ſurrounds us, affords a vaſt variety of fiſh of the moſt delicious flavour, and its ſhores abundance of the fineſt turtle and oyſters. In no ſituation indeed are the conveniencies and luxuries of life enjoyed in greater profuſion.

The advantages of the iſland in a political and commercial view, are too obvious to require to be pointed out.

1790. Nov. 1.

Dr Johnſton on the lymphatic glands.

Phyſ. Cl. Dr Duncan read a printed paper, being a communication from Dr James Johnston of Worceſter, entitled, Thoughts on the Functions and Diſeaſes of the Lymphatic Glands.

Lit.

1790. Nov. 15. Dr Doig on the ancient Hellenes.

Lit. Cl. Mr DALZEL read the firſt part of a Diſſertation concerning the ancient *Hellenes*, by DAVID DOIG, LL. D. Maſter of the Grammar-ſchool of Stirling.

Dec. 6. Dr Hutton on the theory of rain.

Phyſ. Cl. Dr HUTTON read farther Obſervations on the Theory of Rain. [See his Diſſertations above referred to, Diſſertation III. Part I.]

Mr Lochead's account of a bituminous lake.

Dr WALKER alſo communicated an Account of a Bituminous Lake in the iſland of Trinidad, by Mr WILLIAM LOCHEAD, Surgeon in Dominica.

Dec. 20. Mr Fraſer Tytler on tranſlation.

Lit. Cl. Mr FRASER TYTLER read the firſt part of an Eſſay on the Principles of Tranſlation.

1791. Jan. 3. Method of cultivating the *oldenlandia umbellata*.

Phyſ. Cl. An Account of the method of cultivating the *Oldenlandia Umbellata*, or *Ché Plant*, tranſlated from the *Talinga* language by Dr ANDERSON of Madraſs, was communicated to the Society.

THE firſt thing to be attended to is the gathering of the ſeeds. When the plants are well grown and red-coloured, and after they have flowered and produced fruit and long roots, then it is time to get the ſeed. As the ſeeds are very ſmall, and drop down under the plant, they can only be gathered with the ſand, which muſt be kept in a heap till next year, as it cannot be uſed that year. The ground on which the ſeed is to be ſown, ſhould be ſandy, ſupplied with ſweet water, and well manured with ſheeps dung. It is then to be plowed, the more frequently the better, perhaps ſeven or eight times. It muſt be perfectly level and clean, and divided into beds of one yard broad, and four yards long, with a narrow water-courſe between. The ſeeds muſt be ſown thinly in theſe beds, and palmira leaves ſpread over the ſurface, and the water poured on them to prevent the ſeeds from being waſhed out of the earth, until they ſhoot up, which will be in five or ſix days. For two

2 months

months after this, the ground muſt be kept conſtantly wet, and ſprinkled beſides with water, having cow-dung mixed with it, every morning, to prevent the ſhoots from being blown off by the wind. During the remaining months, the cow-dung may be omitted, and the ground only watered twice a-day, morning and evening. Graſs muſt not be allowed to grow. If managed as above, the plants will be perfect in ſix months, when they muſt be dug up with a long iron bar, to prevent the roots being broken, and bound up in ſmall bundles, that are to be dried and bound into larger bundles, of two maunds, or 150 pound weight.

AFTER cutting or beating off the upper part, the roots muſt be well powdered, and mixed with four times their quantity of water in a pot, and boiled for ſome time, to prepare them for painting and dying red. For the painted calengary or chintz, the painters uſe other ſtuffs, together with Ché root, according to their convenience, as Brazil wood, to ſhow them where the red is to be put; but the Ché root is the principal.

THE ground that is once planted with Ché root cannot be uſed again for the ſame purpoſe for ſix years.

1791. Jan. 3. Dr Blair on the unequal refrangibility of light.

AT this meeting, there was alſo read the firſt part of a paper, entitled, Experiments and Obſervations on the Unequal Refrangibility of Light, by Dr ROBERT BLAIR, Regius Profeſſor of Aſtronomy in the Univerſity of Edinburgh.

Jan. 17. Mr Fraſer Tytler on tranſlation.

Lit. Cl. Mr FRASER TYTLER read the ſecond part of his Eſſay on the Principles of Tranſlation. This eſſay has been ſince publiſhed ſeparately.

Jan. 24. General Meeting.

A GENERAL Meeting of the Society was held for the Election of Members. [See Appendix to the Hiſtory of the Society.]

1791. Feb. 7. Dr Hutton on periodical winds, &c.

Phyſ. Cl. Dr HUTTON read two papers; the firſt contained Obſervations on the Periodical Winds which prevail in Britain during the ſpring and autumn; the ſecond, An Eſſay on the Flexibility of the Braſilian Stone. The firſt of theſe papers is publiſhed in the work referred to above, *viz. Diſſertations*, &c. by Dr JAMES HUTTON, and is the fourth Diſſertation of the firſt part. The ſecond is publiſhed in this volume. [*Phyſ. Cl.* No. III.]

Feb. 21. M. Chevalier's *Tableau*, &c.

Lit. Cl. M. CHEVALIER, of the Academies of Metz, Caſſel, and Rome, read the firſt part of a paper, entitled, *Tableau de la Plaine de Troye*, accompanied with Maps.

Feb. 28. M. Chevalier's *Tableau*, &c.

Lit. Cl. AT an extraordinary Meeting of the Society, M. CHEVALIER read the ſecond part of his paper above mentioned.

March 7. Dr Hutton on phlogiſton.

Phyſ. Cl. Dr HUTTON read the laſt of a ſeries of papers on Phlogiſton, of which the reſt had been formerly communicated to the Society, and which are all publiſhed in the ſecond part of the Doctor's Diſſertations above quoted.

March 21. M. Chevalier's *Tableau*, &c.

Lit. Cl. M. CHEVALIER read the ſequel of his paper, *viz. Tableau de la Plaine de Troye*. The paper is publiſhed in this volume. [*Lit. Cl.* No. I *.]

Biographical account of Sir James Hunter Blair.

AT this Meeting, Mr GREENFIELD alſo read a Biographical Account of the late Sir JAMES HUNTER BLAIR, Bart. [See Appendix to the Hiſtory of the Society in this volume.]

Phyſ.

* *N. B.* By authority of the Committee of publication, and at the deſire of the Author, this paper has been tranſlated into Engliſh, and accompanied with large Notes, by Mr DALZEL, Profeſſor of Greek in the Univerſity of Edinburgh, and publiſhed ſeparately in 4to: Which Tranſlation and Notes have been, by permiſſion of the Committee, tranſlated into German, under the inſpection of M. HEYNE of Göttingen; with a Preface, additional Notes, and a Diſſertation, written by M. HEYNE himſelf, and publiſhed at Leipſic in 8vo.

Phyf. Cl. The fequel of Dr BLAIR's paper was read, *viz.* Experiments and Obfervations on the Unequal Refrangibility of Light. The paper is publifhed in this volume. [No. I. *Phyf. Cl.*] 1791. April 4. Dr Blair on the unequal refrangibility of light.

Lit. Cl. The remainder of Dr DOIG's Differtation on the ancient Hellenes was read. April 18. Dr Doig on the ancient Hellenes.

A GENERAL Meeting of the Royal Society was held for the election of Members. [See Appendix to the Hiftory of the Society.] June 27. General Meeting.

Phyf. Cl. There was read an Analyfis of the Waters of the Hot Springs of Geyzer and Rykum in Iceland, by Dr BLACK, Profeffor of Chemiftry in the Univerfity of Edinburgh. The paper is publifhed in this volume. [No. IV. *Phyf. Cl.*] July 4. Dr Black's analyfis of the waters of Geyzer and Rykum.

Lit. Cl. Mr DALZEL read an Account of a Journey made from Rome to Tivoli, by ANDREW LUMISDEN, Efq; with a Defcription of a Marriage-ceremony, taken from a bas-relief on a farcophagus at Tivoli, being a letter from the Author, addreffed to JOHN MACGOWAN, Efq; Edinburgh. This paper, as being intended by Mr LUMISDEN for a part of a larger work, was not put into the hands of the Committee for publication. July 18. Mr Lumifden's journey to Tivoli.

Phyf. Cl. Dr HUTTON communicated fome additional Obfervations on Granite. Thefe make part of the paper referred to above. [No. II. of this volume, *Phyf. Cl.*] Aug. 1. Dr Hutton on granite.

Phyf. Cl. A Letter was read from JOHN THOMAS STANLEY, Efq; M. P. to Dr BLACK, giving an Account of the Hot Springs of Rykum in Iceland. This letter is publifhed in this volume. [No. V. *Phyf. Cl.*] Nov. 7. Mr Stanley's account of the hot fprings of Rykum.

1791. SOME papers were alſo communicated at this meeting, from Mr LINDSAY, Surgeon in Jamaica.

Nov. 21. Dr Ogilvy on the theology of Plato.

Lit. Cl. There was read the firſt part of an Eſſay on the Theology of PLATO, by the Reverend Dr OGILVY of Midmar in Aberdeenſhire.

Nov. 28. General Meeting.

A GENERAL Meeting of the Royal Society was held for the election of Office-bearers. [*Vide* Appendix to the Hiſtory of the Society in this volume.]

Dec. 19. Dr Ogilvy on the theology of Plato.

Lit. Cl. A ſecond part of Dr OGILVY's Eſſay mentioned above was read.

1792. Jan. 2. Account of a variety of the bramble.

Phyſ. Cl. An Account was read of a variety of the Bramble found on the banks of Lochneſs in Inverneſs-ſhire, in a letter to Sir JAMES HALL from WILLIAM HALL, Eſq; of Whitehall.

" *Whitehall, ſhire of Berwick, Dec.* 1. 1791.

" WHEN I was in the Highlands in the year 1787, I found " on the banks of Lochneſs a plant which had ſome reſem- " blance to the common bramble, yet ſeemed to differ conſider- " ably from it in its habit or manner of growth. As the in- " habitants ſaid it bore a ſweeter berry than the bramble, I " procured ſome roots of it, and ſince that time have cultivated " them in my garden here. I have obſerved it to poſſeſs the " following characters.

" IT is of the genus *Rubus* of LINNÆUS. Though it ap- " pears to be akin both to the raſp (*Rubus Idæus*) and to the " bramble, (*Rubus Fruticoſus*), it differs in ſome reſpects from " both. One or more erect ſtalks, with a very few ſhort " prickles,

" prickles, ſhoot up from each root, and bear no fructification
" the firſt year. In their ſecond year, they begin to produce
" flowers about the ſame time with the raſp-berry, in the firſt week
" of June, three or four weeks before the bramble; but the fruit
" does not come to maturity till the intermediate time between
" ripening of the raſp-berry and bramble-berry, that is, about
" the beginning of September. The fruit, which is of the colour
" of the red mulberry, has a peculiar taſte, ſomewhat different
" from both. After bearing fruit, the ſtalk periſhes in the ſecond
" year, like that of the raſp; but the root continues to produce
" new ſhoots yearly, like that plant. Its characters may be ex-
" preſſed, in the Linnæan ſtyle, as follows:

" *Rubus (Neſſenſis) foliis quinato-digitatis, ternatis, ſepteniſque*
" *nudis, caule ſubinermi, petiolis canaliculatis; ſtolonibus erectis bi-*
" *ennalibus.*

" As it is ſo nearly akin both to the raſp and the bramble,
" it may perhaps be only a variety of one or t'other. But as
" it is to be met with in different places on the banks and among
" the woods of Lochneſs, where it could not come from the
" ſame root, it muſt have been propagated by the ſeed, and
" would therefore ſeem to be a different ſpecies from either, and
" from any other *Rubus* that I know of. I am," &c.

1792. Jan. 2. Mr Leſlie on electricity.

At this meeting, was alſo read the firſt part of a paper on Electricity, by Mr John Leslie.

Jan. 16. Dr Ogilvy on the theology of Plato.

Lit. Cl. A part of Dr Ogilvy's paper on the Theology of Plato was read in continuation. The Society obſerved with regret, that the diſcuſſions of a religious nature contained in this learned communication, rendered an admiſſion of it among their papers inconſiſtent with the nature of their plan; and therefore it was not put into the hands of the Committee for publication.

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1792.
Jan. 23.
General Meeting.

A GENERAL Meeting of the Royal Society was held for the election of Members. [See the Appendix to the Hiſtory.]

March 5.
Mr Leſlie on electricity.

Phyſ. Cl. The remainder of Mr LESLIE's paper on Electricity was read. [*Vide ſupra*, Jan. 2.]

April 2.
Mr Playfair on poriſms.

Phyſ. Cl. A paper was read on the Origin and Inveſtigation of Poriſms, by Mr PLAYFAIR. The firſt part only of the paper was communicated, and it is publiſhed in this volume. [*Phyſ. Cl.* No. VII.]

June 4.
Dr Butter on the cure of St Vitus's dance.

Phyſ. Cl. An Account was read of an Application of Hemlock to the Cure of St Vitus's Dance, by Dr BUTTER of London.

June 25.
General Meeting.

A GENERAL Meeting of the Society was held for the election of Members. [See the Appendix to the Hiſtory.]

July 2.
Mr Taite's deſcription of moſſes in Perthſhire.

Phyſ. Cl. A paper was read, containing a Deſcription of the Moſſes of Kincardine and Flanders in Perthſhire, by the Reverend Mr CHRISTOPHER TAITE, Miniſter at Kincardine. The paper is publiſhed in this volume. [No. III. *Lit. Cl.*]

Nov. 5.
Dr Monro's deſcription of a male monſter.

Phyſ. Cl. Dr MONRO read a Deſcription of a Human Male Monſter, which is publiſhed in this volume. [No. IX. *Phyſ. Cl.*]

Nov. 26.
General Meeting.

A GENERAL Meeting of the Society was held for the election of Office-bearers. [See the Appendix to the Hiſtory.]

Dec. 17.
Biographical Account of Dr Dryſdale.

Lit. Cl. Mr DALZEL read a Biographical Account of the late Reverend Dr DRYSDALE. [See the Appendix to the Hiſtory of the Society.]

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APPENDIX.

LIST of MEMBERS *or* FELLOWS *of the* ROYAL SOCIETY *of* EDINBURGH, *continued from the ſecond Volume.* [Hiſtory of the Society, Appendix.]

THE following Members were elected at the General Meeting, Jan. 25. 1790. Members choſen, Jan. 25. 1790.

RESIDENT.

Francis Garden, Eſq; of Gardenſton, one of the Senators of the College of Juſtice. *L.*
William Farquharſon, M. D. Edinburgh. *P.*
William Tait, Eſq; Advocate. *L.*

NON-RESIDENT.

Sir *William Jones*, Bart. Preſident of the Aſiatic Society, Calcutta. *L.*
Joſeph Ewart, Eſq; Miniſter Plenipotentiary of his Britannic Majeſty at Berlin. *L.*
Hugh Cleghorn, Eſq; Profeſſor of Civil Hiſtory in the Univerſity of St Andrew's. *L.*

FOREIGN.

John Benjamin Jachman, M. D. Koningſberg. *P.*
Chriſtopher Girtanner, M. D. of St Gall, Switzerland; correſponding Member of the R. S. at Gottingen. *P.*
Count *Reden*, Director of the Mines in Sileſia. *P.*
M. de la Grange, of the Royal Academy of Sciences at Paris. *P.*

HONORARY.

Baron *Hertzberg*, Berlin.

Members chosen, June 28. 1790.

THE following were elected at the General Meeting, June 28. 1790.

RESIDENT.

Norman Macleod, Esq; of Macleod. *L.*

NON-RESIDENT.

Francis Kinloch, Esq; of Gilmerton. *P.*

Members chosen, Jan. 4. 1791.

THE following were elected at the General Meeting, Jan. 4. 1791.

RESIDENT.

John Burnet, Esq; Advocate. *L.*

NON-RESIDENT.

Charles Scott, M. D. London. *P.*
James Clerk, M. D. Dominica. *P.*
Mr *William Lochead*, Surgeon, Antigua. *P.*
Mr *Alexander Anderson*, Intendant of the Royal Botanical Garden, St Vincent's. *P.*
William Roxborough, M. D. Madras. *P.*

FOREIGN.

M. Chevalier, of the Academies of Metz, Cassel and Rome. *L.*

The following were elected at the General Meeting, June 27. 1791. Members chosen, June 27. 1791.

NON-RESIDENT.

Daniel Braithwaite, Esq; F. R. S. Lond. *L.*
Robert Townson, Esq; *P.*
James Anderson, M. D. Madras. *P.*
James Bell, D. D. Coldstream. *L.*

The following were elected at the General Meeting, Jan. 23. 1792. Members chosen, Jan. 23. 1792.

RESIDENT.

William Hall, Esq; of Whitehall. *P.*
Andrew Coventry, M. D. Professor of Agriculture in the University of Edinburgh. *P.*
John Rotheram, M. D. *P.*

NON-RESIDENT.

Sir *Joseph Banks*, Bart. P. R. S. Lond. *P.*
William Saunders, M. D. London. *P.*
Maxwell Garthshore, M. D. London. *P.*
John Stark Robertson, M. D. Bath. *P.*
Alexander Hunter, M. D. York. *P.*
Alexander Johnson, M. D. London. *P.*

FOREIGN.

Dr *Kemp*, Professor of Mathematics in Columbia College, New York. *P.*

Members chosen, June 26. 1792.

THE following were elected at the General Meeting, June 26. 1792.

NON-RESIDENT.

Theophilus Houlbrooke, Esq; *P.*
George Robertson, Esq; in the service of the Honourable East India Company. *P.*

Members chosen, Jan. 27. 1793.

THE following were elected at the General Meeting, Jan. 27. 1793.

RESIDENT.

Alexander Muir Mackenzie, Esq; *L.*

NON-RESIDENT.

Richard Pulteney, M.D. Blanford, Dorsetshire, F. R. S. Lond. *P.*
Mr *John Lindsay*, Surgeon in Westmoreland, Jamaica. *P.*
Mr *Mackay*, of the Observatory, Aberdeen. *P.*
Thomas Wallace, Esq; of Carlton Hall, Cumberland. *L.*

FOREIGN.

Don Antonio Gimbernat, First Surgeon to the King of Spain, and Director of the Royal College of Surgery at Madrid. *P.*
Samuel Latham Mitchill, M. D. Professor of Economics, Columbia College, New York. *P.*

Members chosen, June 24. 1793.

THE following were elected at the General Meeting, June 24. 1793.

NON-RESIDENT.

Thomas Newte, Esq; of London. *P.*
Thomas Somerville, D. D. at Jedburgh. *L.*

OFFICE-

Office-bearers of the Society.

General office bearers.

Office-Bearers elected for the enfuing Year, at the General Meeting held for that purpofe, Nov. 29. 1790.

Prefident.

His Grace the Duke of Buccleugh.

Vice-Prefidents.

Lord *Dunfinnan.* | Right Hon. *Henry Dundas.*

Secretary.

Profeffor *John Robifon.*

Treafurer.

Mr *Alexander Keith.*

Counfellors.

Mr *Benjamin Bell.*
Mr *Greenfield.*
Mr *George Ferguffon.*
Dr *Gregory.*
Dr *Rutherford.*
Profeffor *Stewart.*
Profeffor *Ferguson.*
General *Fletcher Campbell.*
Mr *Mackenzie.*
Lord *Dreghorn.*
Commiffioner *Edgar.*
Lord *Elliock.*

Office-bearers of the claſſes.

OFFICE-BEARERS of the two CLASSES.

PHYSICAL CLASS.

Preſidents.

Dr *Black.*	Dr *Home.*
Dr *Hutton.*	Dr *Monro.*

Secretaries.

Profeſſor *Playfair.*	Dr *Walker.*

LITERARY CLASS.

Preſidents.

Mr Baron *Gordon.*	Principal *Robertſon.*
Sir *William Miller.*	Dr *Hugh Blair.*

Secretaries.

Mr *Fraſer Tytler.*	Profeſſor *Dalzel.*

AT the General Meetings in 1791 and 1792, the ſame office-bearers were re-elected.

LIST

LIST of MEMBERS deceaſed, continued from the ſecond volume.

Members deceaſed.

William Cullen, M. D. Profeſſor of the Practice of Phyſic in the Univerſity of Edinburgh, *&c.* Feb. 5. 1790.

William Hamilton, M, D. Profeſſor of Anatomy and Botany in the Univerſity of Glaſgow. March 13. 1790.

David Stuart Moncreiff, Eſq; one of the Barons of Exchequer. April 17. 1790.

John Leſlie, M. A. Profeſſor of Greek, King's College, Aberdeen. May 24. 1790.

Major General *William Roy*, F. R. S. Lond. May 30. 1790.

Alexander Millar, Eſq; Advocate. June 30. 1790.

Henry Cullen, M. D. one of the Phyſicians of the Royal Infirmary, Edinburgh. Oct. 11. 1790.

Robert Henry, D. D. one of the Miniſters of Edinburgh. Nov. 24. 1790.

David Erſkine, Eſq; Writer to the Signet. April 5. 1791.

John Steedman, M. D. April 16. 1791.

James Gilleſpie, D. D. Principal of St Mary's College, St Andrew's. June 2. 1791.

Alexander Stevenſon, M. D. Profeſſor of Medicine in the Univerſity of Glaſgow. June 4. 1791.

Adam Smith, Eſq; LL. D. Commiſſioner of his Majeſty's Cuſtoms, *&c.* July 17. 1791.

The Reverend Mr *Matthew Murray*, Miniſter of North Berwick. Auguſt 13. 1791.

Joſeph Ewart, Eſq; his Majeſty's Miniſter Plenipotentiary at Berlin. Jan. 27. 1792.

Robert Adam, Eſq; Architect, F. R. S. Lond. March 3. 1792.

The Right Hon. *John Earl of Bute*, &c. March 10. 1792.

William Tytler, Eſq; of Woodhouſelee, Writer to the Signet. Sept. 12. 1792.

John Ruſſell junior, Eſq; Writer to the Signet. Dec. 2. 1792.

Colonel *Andrew Fraſer*, of the Engineers. 1792.

William Chalmers, M. D. Profeſſor of Medicine, King's College, Aberdeen. Dec. 14. 1792.

William Robertſon, D. D. Principal of the Univerſity of Edinburgh, &c. June 11. 1793.

George Stuart, LL. D. Emeritus Profeſſor of Humanity in the Univerſity of Edinburgh. June 18. 1793.

William Morehead, Eſq; of Herbertſhire. June 19. 1793.

FOREIGN MEMBERS deceaſed.

Benjamin Franklin, Eſq; LL. D. April 17. 1790.

M. le Clerc de Sept Chênes, Paris. 1791.

SINCE the publication of the ſecond volume, the following BIOGRAPHICAL ACCOUNTS have been read at different Meetings of the Claſſes *.

I. Ac-

* N. B. The Publication of the Biographical Account of the late Dr ALEXANDER WILSON, Profeſſor of Practical Aſtronomy in the Univerſity of Glaſgow, is delayed at the requeſt of his ſon ; as ſome papers have been miſlaid, which he hopes may ſtill be recovered, and which will render the Account in a future volume more complete. [See Hiſtory of the Society, p. 3. in this volume.]

I. ACCOUNT *of Sir* JAMES HUNTER BLAIR, *Bart.*

[*Read by Mr* GREENFIELD, *March* 21. 1791.]

THE following account of a late refpectable Member will not, I am perfuaded, be unacceptable to the Society. He was one of the twenty-two who obtained the charter of its incorporation; and although his fituation did not permit him to aim at literary diftinction, he is entitled to an honourable place in its records, both from the worth of his private character, and alfo from his eminent activity and ufefulnefs in public life.

Sir JAMES HUNTER BLAIR was the fecond fon of Mr JOHN HUNTER, merchant in Ayr, and was born in that town on the 21ft day of February 1741. His father acquired a confiderable property in land and money, and left his children, who were ftill young at his death, in eafy circumftances.

IN the year 1756, Sir JAMES was placed as an apprentice in the houfe of COUTTS, Brothers and Company, Bankers in Edinburgh. It was at this time that his friendfhip commenced with Sir WILLIAM FORBES, who had entered into the fame fituation about two years before, and who was afterwards his partner in bufinefs. Sir WILLIAM, in a very interefting letter, written after Sir JAMES's death, expreffes himfelf thus: " Our friendfhip terminated only with his life, after an intimacy which few brothers can boaft of, during thirty-one years; in which long period, we never had a difference, nor a feparation of intereft."

AFTER

Account of Sir James Hunter Blair.

After the death of Mr John Coutts, the principal partner of the House, Sir William and Sir James were admitted to a ſhare of the buſineſs in 1763, and gradually roſe to the head of the copartnery.

It was alſo in 1763 that Sir James firſt became a member of the Town-council of Edinburgh, during the adminiſtration of Provoſt Drummond, whoſe memory will long be reſpected by the inhabitants of this city. He afterwards continued occaſionally to have a ſeat in the Council, and filled all the different offices of Magiſtracy.

In December 1770, he married Miſs Jane Blair, eldeſt daughter of John Blair, Eſq; of Dunſkey in the county of Wigton. It is remarkable, that this lady's father, at his death, left no fewer than ſix ſons, four of whom were alive at the time of their ſiſter's marriage, but all of them having died, ſhe ſucceeded in 1777 to the family-eſtate. Sir James on this occaſion, received the name of Blair, and was afterwards, in the year 1786, created a Baronet of Great Britain.

On the eſtate which had thus unexpectedly devolved to him, he commenced a plan of moſt extenſive and judicious improvement. He nearly rebuilt the town of Portpatrick; he repaired and greatly improved the harbour; he eſtabliſhed packet-boats of a larger ſize on the much frequented paſſage to Donaghadee in Ireland; and, laſtly, while the farmers in that part of Scotland were extremely ignorant of their buſineſs, he ſet before them a ſucceſsful example of the beſt modes of agriculture, the greateſt ſervice perhaps which can be performed by a private man to his country.

In September 1781, upon the death of the Member at the time he was called, without any ſolicitation upon his part, to repreſent the city of Edinburgh in Parliament; and at the general election in ſummer 1784, he alſo received the ſame honour of an unſolicited and unanimous nomination; an event almoſt ſingular at that period of violent political ſtruggle. But before the

Account of Sir James Hunter Blair.

the end of the firſt ſeſſion, he reſigned his ſeat, as he found the attention required by his buſineſs inconſiſtent with his attendance in Parliament, and he did not chuſe to retain a place when he could not diſcharge the duties of it properly.

At Michaelmas 1784, in compliance with the urgent requeſt of the Town-Council, he was elected Lord Provoſt of Edinburgh; and in this ſituation, he exerted, in a very conſpicuous manner, the indefatigable activity of his public ſpirit. For it was he who ſet on foot thoſe great operations which are at preſent carrying on for the improvement of the city, and of which one of the moſt important objects was the rebuilding of the College.

The firſt ſtep of theſe operations was a work of great utility and magnificence. The acceſs to Edinburgh from the ſouth, on account of the narrowneſs and ſteepneſs of the lanes, was not only very incommodious, but even hazardous; and accordingly, it had often been propoſed to open a communication between the High Street and the ſouthern parts of the city and ſuburbs, by means of a bridge over the Cowgate. But the ſcheme, although its great importance was abundantly obvious, appeared ſo expenſive, and was attended with ſo many other difficulties, that every former attempt had proved unſucceſsful, and it required all the ardour and influence of Sir James Hunter Blair to carry it into execution.

We owe the accompliſhment of it, however, not merely to his ardour and influence, but alſo to his ſagacity. For in order to defray the great expence, he deviſed means, which, to men of leſs diſcernment or knowledge in buſineſs, appeared very inadequate to the purpoſe. His ſcheme was this: The property which lay in the line of the intended communication, and to a conſiderable diſtance on each ſide of that line, was to be purchaſed at its real value at the time; and after the communication was opened, ſuch parts of the ground thus purchaſed as

Account of Sir James Hunter Blair.

were not to be left vacant, were to be ſold again for the purpoſe of erecting buildings according to a plan. Sir JAMES conceived, that the ſale of theſe areas, in conſequence of the great improvement of their ſituation, would raiſe money ſufficient, not only to pay for the firſt purchaſe of the property, but alſo to defray the expence of building the bridge, and whatever elſe was neceſſary for completing the communication. But leſt there ſhould be any deficiency, and likewiſe to afford a ſecurity for borrowing the money which might be requiſite, the truſtees for carrying on the work were to be empowered to levy a ſum not exceeding 10 *per cent.* of the valued rents of the houſes in Edinburgh and the environs; and in order to remove all juſt cauſe of complaint, he propoſed, that if any of the owners of the property to be purchaſed ſhould not agree with the truſtees, the price of their property ſhould be fixed by the verdict of a jury, the jury conſiſting of fifteen perſons, who were choſen by lot out of forty-five proprietors of houſes or land in the city or county, named by the Sheriff in each particular caſe.

THESE propoſals were publiſhed in November 1784, and met with the ſame reception which has often attended ſchemes of ſtill greater importance and more extenſive utility. They were cenſured and oppoſed from various quarters, and ſometimes even with virulence. A man of leſs ardour and public ſpirit would have yielded to the diſcouragements which Sir JAMES experienced on this occaſion. Fortunately, he was of ſuch a temper, that they ſerved only to rouſe his exertions, without rendering him leſs prudent in his meaſures. His perſeverance ſurmounted every oppoſition. An act of Parliament was obtained for carrying into execution, not only the plan which has been mentioned, but likewiſe ſeveral others of great conſequence to the place; and on the 1ſt day of Auguſt 1785, the work was begun, by laying the foundation-ſtone of the bridge,

which

which now connects, by an eafy and fpacious communication, the fuburbs on the fouth with the reft of the city.

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WITHIN little more than two years, (fuch was the activity of the managers), the bridge was completely finifhed; and although the expence, including the firft purchafe of the property, amounted to not lefs than L. 63,000, yet it is expected, when the areas which ftill remain to be fold are difpofed of, and the prices of thofe already fold are paid up, that the truftees for the bridge will be enabled to pay over to the Magiftrates, for the purpofe of carrying on the reft of the intended improvements, the whole or the greateft part of the 10 *per cent.* affeffment.

Sir JAMES lived only to fee the commencement of the great works which he had projected. In fpring 1787, he went to Harrowgate for the recovery of his health, but without the appearance of any alarming complaint. The waters had not the fuccefs which was expected. In the month of June, his indifpofition was much increafed, and terminated in a fever. He died on the 1ft day of July 1787, in the 47th year of his age. His remains were conveyed to Edinburgh, and depofited in the Grayfriars Church-yard. On this occafion, the Magiftrates and Council, and the Principal and Profeffors of the Univerfity, attended in their gowns of office, to teftify their refpect for his character, and their fenfe of the importance of his fervices; and the public in general lamented fincerely, that a man fo active and zealous, and fo much fuperior to narrow and felfifh views, was not fpared to complete what he had fo happily begun.

IN private life, he was affable and cheerful, warmly attached to his friends, and anxious for their fuccefs. In bufinefs and in his public exertions, he was upright, liberal, difinterefted and patriotic: And he poffeffed, in no common degree, thofe talents which are requifite for rendering benevolence effectual;

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for to an unwearied application, he united great knowledge of the world, ſagacity in buſineſs, and a ſound underſtanding. His virtues and labours were not unrewarded. His life was ſhort indeed, but it was proſperous and happy; he enjoyed a very great ſhare of the public eſteem; in ſpite of the intereſts and prejudices which he combated, he had no perſonal enemies; of the numbers whom he obliged, few were ungrateful; he was beloved by his friends; and no man perhaps was ever bleſſed with a greater portion of domeſtic felicity.

II. Ac-

II. Account *of John Drysdale*, D. D.

[*Read by Mr* Dalzel, *Dec.* 17. 1792.]

If that ſound judgement, which diſcerns what is right and wrong, with uncommon acuteneſs and preciſion; that firm adherence to rectitude of conduct, which excites admiration, and commands reſpect; thoſe generous and benevolent diſpoſitions of heart, and that indefatigable attention and beneficence to friends, which produce the moſt ardent affection, gratitude, and attachment on the part of thoſe friends; that argumentative, powerful, and animated eloquence, which comes from the heart, and irreſiſtibly impreſſes on the minds of the hearers, the ſublime truths of religion and morality; that ardour of mind, and thoſe ſuperior talents, which are reſtrained only by invincible diffidence and modeſty, from informing and pleaſing mankind by the production of various works of literary genius;—if a character poſſeſſed of ſuch endowments and qualities as theſe, has any claim to be recorded among the monuments of men, the memory of the perſon who is the ſubject of the following narrative, ought not to be ſuffered to paſs into oblivion.

Dr John Drysdale was born at Kirkaldy, in the county of Fife on the 29th day of April 1718; being the third ſon of the Reverend Mr John Drysdale, Miniſter of Kirkaldy, and of Anne Ferguson, daughter of William Ferguson, Eſq; Provoſt,

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Provoſt, or chief Magiſtrate, of the ſame town. He received the elements of claſſical learning at the pariſh ſchool, under DAVID MILLER, a man who had alſo the honour of inſtructing the celebrated ADAM SMITH, and JAMES OSWALD of Dunikeir, perſons who have reflected ſo much luſtre on their country, the one as a philoſopher and man of letters, and the other as an eminent ſtateſman. Under the ſame maſter, were alſo educated Dr JOHN OSWALD, Biſhop of Raphoe in Ireland, and Dr GEORGE KAY, one of the miniſters of Edinburgh, men likewiſe of conſiderable talents and accompliſhments. So that MILLER had reaſon to boaſt, that few individual maſters of the moſt opulent and celebrated ſchools, had ſent from their tuition a greater number of eminent men, than had been ſent by him from the obſcure ſchool of Kirkaldy.

WHILE at ſchool, JOHN DRYSDALE greatly diſtinguiſhed himſelf as a claſſical ſcholar; and there he contracted that ſtrict friendſhip with the moſt eminent of his ſchoolfellows, particularly Mr OSWALD and Mr SMITH, which continued unimpaired through life. When he was thought to be ſufficiently prepared for the Univerſity, to which young men go at a much earlier period in this country than in England, he was ſent to College at Edinburgh in the year 1732. He there proſecuted his ſtudies with great ſucceſs, and ſoon attracted the notice of the Profeſſors, by the rapid progreſs he made in the acquiſition of knowledge. After paſſing through the ordinary courſes of languages and philoſophy, he engaged in the ſtudy of divinity, the ultimate object of his repairing to the Univerſity; and having proſecuted this the uſual time, he was admitted to trials, according to the forms of the Church of Scotland, before the Preſbytery of Kirkaldy; and by them licenſed to preach the Goſpel, in the year 1740.

HE was ſoon after employed as aſſiſtant to the Reverend Mr JAMES BANNATYNE, miniſter of the College Church, Edinburgh; and while he publicly officiated there, he was much

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admired as an original, powerful, and rational preacher. His diſtinguiſhed abilities, great integrity, goodneſs of heart, and agreeableneſs of manners, now procured him the friendſhip and confidence of ſeveral other perſons, who afterwards became celebrated in the republic of letters; and, about this time, a particular incident occurred, which was an earneſt of that generoſity of mind, for which he was afterwards ſo remarkable. Mr OSWALD, who was now making a figure in public life, had remained his firm friend, and had promiſed to beſtow on him the firſt living in the Church he ſhould be able to procure. The pariſh of Kennoway, in Fife, became vacant, and at the diſpoſal of Mr OSWALD; but Mr DRYSDALE having heard, that his friend was embarraſſed by a certain political connection, which made it extremely eligible to beſtow that living upon another candidate, he took an early opportunity of waiting on Mr OSWALD, and having voluntarily renounced his claim, he begged of his friend by all means to yield to the political application in favour of his rival; for which Mr OSWALD ever after conſidered himſelf as under the greateſt obligation to him. Indeed, at every period of his life, the conferring of a favour on a friend, was to Mr DRYSDALE a much more powerful motive of action, than the view of obtaining any perſonal emolument; and in examining the foundations of morality, a ſubject in which, as well as his friend Mr SMITH, he took great delight, and to which he had paid particular attention, the feelings of his own mind were ſufficient to induce him to reject with diſdain the ſyſtem of thoſe philoſophers who deduce all human actions from a ſelfiſh ſource.

IN the year 1748, he obtained a Crown-preſentation to the church of Kirkliſton in Weſt Lothian, by the intereſt of the late JOHN Earl of Hopetoun, to whom he had been recommended by WILLIAM ADAM, Eſq; of Maryburgh, Architect, whoſe third daughter he afterwards married.

IN

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In entering upon this charge, he met with ſome ſlight oppoſition, owing to an opinion induſtriouſly propagated, that the ſtyle and method of his preaching were not ſufficiently popular, and that his diſcourſes contained too great a proportion of the doctrines of morality. But this objection was ſoon obviated, after the people of the pariſh became better acquainted with him: among whom he had not remained long, till he became the object of a very general regard and eſteem, not only by the kindneſs of his diſpoſition and his unwearied beneficence, but from the intereſting and animated method in which he inculcated the great truths of religion and morality in his ſermons. Never were diſcourſes better calculated to command the attention, and influence the conduct, than thoſe which he preached to the crowded congregations that attended him.

Though he had accuſtomed himſelf to compoſe and write ſermons with great care, yet he ſeldom, eſpecially in the earlier part of his life, uſed to carry his written diſcourſes to the pulpit. His uſual method of preaching was, after carefully ſtudying the ſubject, to ſpeak from the heads of diſcourſe which he had marked down. Often, when he had entered upon the diſcuſſion of one of thoſe heads, he grew ſo animated, and poured forth ſuch a copious torrent of intereſting illuſtration, that he found the time exhauſted before he had finiſhed one half of what he had intended to ſay. He was therefore obliged to defer the remainder of the ſubject to one or more ſubſequent diſcourſes, which he continued with equal vivacity and force.

He poſſeſſed a moſt uncommon fertility of original thought; and although his eloquence was chiefly argumentative and rational, yet it was ſometimes pathetic, often ſublime, often embelliſhed with the richeſt ornaments of original fancy, always bold and manly, and always marked with the dignity and vigour of an upright mind. Hence he was extremely ſucceſsful in exhibiting the grandeſt and moſt amiable pictures of virtue, and in expoſing the meanneſs and deformity of vice in the

most odious and detestable colours. Whatever he uttered was natural, unaffected, and full of energy, always flowing from the heart, and always discovering a deep penetration into the human mind.

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In entering upon his subject, he seemed at once to seize upon the most proper and rational views of it; and he carried his listening audience along with him, in a rapid and fervid train of just, pure and elevated sentiment, from the beginning to the end of his discourse. His sermons by no means consisted, as had been insinuated, of the mere doctrines of morality. These he certainly did most strenuously inculcate; but, at the same time, no man ever brought home to the minds of his hearers, with greater force and efficacy, the genuine spirit of that religion which he preached.

His mode of delivery, though by no means correct, was extremely animated and striking. His gesture was frequently vehement; and though not always graceful, because not studied, but produced by his real feelings, yet it had a most powerful effect. Nor were the elevations and depressions of his voice by any means consistent with those rules which professed teachers of the art of elocution inculcate. These too were entirely directed by his own sensations, and suited to his own original mode of speaking. But however irregular his tones and his emphasis might sometimes be, still what he uttered came always home to the hearts, and effectually commanded the attention, of every audience.

In that part of the service of the Church of Scotland which consists of a portion of scripture read and explained from the pulpit, and which is called the Lecture, Mr Drysdale displayed uncommon ability and skill. He expounded the scriptures in a plain, simple and connected manner, so as to render the meaning quite intelligible to ordinary capacities. But wherever he found a passage that he either did not clearly understand himself, or despaired of making edifying to his hearers, he

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frankly avowed the difficulty, and told the audience, that inſtead of amuſing them with a variety of conjectures, either of the commentators or of his own, he would paſs on to ſomething from which they would reap much more advantage. For he never loſt ſight of what he had conceived to be the great object of all religious inſtruction, practical improvement, not ſpeculative opinion. The inſtructions and exhortations with which he accompanied the ordinances of religion, particularly the diſpenſing of the ſacrament of the LORD's ſupper, all tended to the ſame end, namely, the amendment of the hearts and lives of his people; and they were all delivered with ſuch earneſtneſs of manner, as convinced the hearers, that they came from a pure and benevolent mind, intent upon promoting their beſt intereſts.

As the ſervice of the Church of Scotland does not admit of ſet forms of prayer, but leaves the miniſter to uſe his own expreſſions in addreſſing the Supreme Being, Mr DRYSDALE's talents were in nothing more conſpicuous than in this eſſential part of public worſhip. He did not indeed aſſume any ſtudied ſolemnity of manner; but, with unaffected gravity and fervour, poured forth the genuine and copious dictates of his heart, in the moſt glowing, various and proper expreſſions; and ſo far was he from repeating any particular ſtudied form of words in his prayers, that his audience uſed to remark, that on hearing the beginning of his ſentences, they ſeldom were able to anticipate the concluſion.

SUCH were his abilities as a miniſter of religion; and with theſe the irreſiſtible amiableneſs of his manners, and the known integrity of his private life, concurred to render him the object of the higheſt eſteem and regard of his pariſhioners. Even the loweſt of the people reſpected and revered his character; and ſuch was the ſucceſs with which his inſtructions were attended, that it was obſerved of the morals of the inhabitants of the village in particular, which had been formerly noted for irregularity

rity and vice, that they underwent a ſurpriſing change for the better, during the time of Mr DRYSDALE's miniſtry;—a ſtrong proof of the great utility of well-qualified teachers of pure and undefiled religion in any ſtate! Account of Dr Dryſdale.

THUS he lived for fifteen years, diſcharging with fidelity the functions of a country clergyman, enjoying the domeſtic ſociety of his own family, and the converſation of many literary and clerical friends who occaſionally viſited him.

AT length, in the year 1763, his ſincere and ſtedfaſt friend Mr OSWALD found an opportunity of ſerving him, by prevailing with the late Earl of BUTE to uſe his influence with the Town-council of Edinburgh, that Mr DRYSDALE might be admitted one of the miniſters of that city. GEORGE DRUMMOND, Eſq; at that time Lord Provoſt of Edinburgh, exerted himſelf with great activity on that occaſion. Though it was pretty well underſtood, that the right of preſenting miniſters to the city was veſted in the Lord Provoſt, Magiſtrates and Council, yet a practice had prevailed for the Council to wave the exerciſe of that right, and to permit the general kirk-ſeſſions of the city to be the electors of their own miniſters. The Lord Provoſt thought proper, for good reaſons, to deviate from that mode of election on this occaſion; and he prevailed with the Council to grant a preſentation to Mr DRYSDALE to ſupply the vacant charge. This produced a conſiderable degree of oppoſition on the part of thoſe who were deſirous that the election of miniſters ſhould remain in the hands of the general ſeſſions. But the Council were determined to maintain what they imagined to be their right; and after a civil proceſs, the queſtion was decided in their favour. Several interlocutors had been paſſed in the Preſbytery of Edinburgh hoſtile to the tranſlation of the preſentee, which cauſed the affair to be brought before the Synod of Lothian and Tweeddale, where they were all over-ruled,

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and the ſettlement ordered to proceed ;—a deciſion which was finally affirmed by the General Aſſembly.

No ſooner did Mr DRYSDALE enter upon his new charge as miniſter of Lady Yeſter's, than all were convinced, that however diſagreeable to ſome the mode of his introduction might be, no oppoſition was due to him as a man, and as a miniſter. The ſermons which he preached in that church attracted always a great concourſe of hearers, whom he never failed to delight and inſtruct by an eloquence of the moſt nervous and intereſting kind. Both his train of thought, and his manner of expreſſion, were evidently ſuch as ſtrongly indicated a vigorous underſtanding, an original genius, and a profound knowledge of the human heart.

HIS reputation as a preacher afterwards roſe ſo high, that on occaſion of an excurſion which he made to London to viſit his friends and relations there, the late Mr STRAHAN earneſtly requeſted, that he would furniſh him with a volume of ſermons for publication. His friends preſſed him much to embrace this propoſal ; and he ſeemed at length diſpoſed to comply with their wiſhes. For on his return to Scotland, he began to reviſe his ſermons with a view to make a ſelection for publication ; but he had not proceeded far till his diffidence induced him to procraſtinate, and at laſt to relinquiſh, every reſolution of that ſort.

THE ſame native diffidence and modeſty were likewiſe the cauſe of his declining to appear as a ſpeaker in the judicatories of the church. While he remained in the country, he ſeemed rather to avoid taking much concern in the management of church-affairs ; but on his coming to Edinburgh, he found himſelf ſo much connected with Dr ROBERTSON, to whom he was always greatly attached as a friend, and to whom he conſidered himſelf as under great obligations, particularly for the earneſt and effectual manner in which he had eſpouſed his in-

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tereſt in his tranſlation to town, that he reſolved to give that eminent leader every aſſiſtance in his power in ſupport of what was called *the moderate party* in the church; the chief object of whoſe policy was, to maintain the right of preſentation as eſtabliſhed by law, againſt thoſe who conſidered that mode of ſettling miniſters of the goſpel as a great grievance, and who ſtood up for the ſuperior juſtice of popular election. With reſpect to the merits of the queſtion itſelf, men will always be found to differ, nor is it proper here to enter upon the diſcuſſion of it. But be it as it may, Mr DRYSDALE was fully perſuaded of the rectitude of that ſide he had embraced; and though he did not ſpeak in the church-courts, Dr ROBERTSON could not have been more fortunate in a co-adjutor. The native benevolence of his heart was conſpicuous in his manners, which were extremely popular and engaging; and no ſooner did he begin to extend his acquaintance with his brethren, than he wonderfully conciliated their eſteem and affection. He took every opportunity of obliging them, both as individuals and as a body; and his influence among them ſoon became very extenſive.

WITHOUT any ſolicitation on his part, and even without his knowledge, the Mariſchal College of Aberdeen conferred on him the degree of Doctor in Divinity, by diploma, bearing date the 15th of April 1765: And the following year, the death of the Reverend Dr JOHN JARDINE having produced a vacancy in the Tron-church, which is collegiate, Dr DRYSDALE was tranſlated thither from Lady Yeſter's, which is a ſingle charge. He there had the good fortune to have for his colleague the Reverend Dr GEORGE WISHART, principal clerk to the Church, for whom he had long entertained the higheſt eſteem and reſpect; and Dr WISHART in his turn, having a moſt ſincere affection for *him*, they found the greateſt comfort in being now ſo nearly connected. Never did two colleagues live together in more cordial and uninterrupted habits

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of friendship; their constant study being to oblige each other by a perpetual series of mutual good offices.

By the death of Dr JARDINE likewise, Dr DRYSDALE now obtained a share in the few clerical offices which the Crown has to bestow on the clergy of Scotland. By Royal warrant, he was appointed one of his Majesty's chaplains, with one third of the emoluments of the Deanry of the Chapel Royal. The late Marquis of Rockingham was then Prime Minister; and he was determined in his choice of Dr DRYSDALE solely by the recommendation of Dr ROBERTSON.

As this office much improved Dr DRYSDALE's pecuniary circumstances, it furnished him with the means of indulging his inclination for domestic hospitality to a much greater extent than he had hitherto done. His house was open at all times to his numerous friends and acquaintance, and it was their frequent place of resort. There, in particular, many of the younger clergy, and other young men, enjoyed the advantage of his agreeable conversation, and never were happier than when in his company. There was something so cheerful, so unassuming, so benign, and, at the same time, so upright and decided in his manner, that he gained the esteem and good will of all who had any connection with him, without ever exciting the least degree of envy. Even such as were of different sentiments in church affairs esteemed the man; and with several of these he maintained a very friendly intercourse. As his turn of thinking on all subjects was clear, acute and judicious, he was very expert in the method of conducting affairs. He had a peculiar facility and elegance of expression in the numerous letters he had occasion to write, in a most extensive correspondence which he carried on throughout the Church. No person who applied to him for a favour from the remotest parts of the kingdom ever found the application treated with neglect; but, on the contrary, he was soon convinced, that Dr DRYSDALE had made every practicable exertion in his behalf. With

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ſuch talents, and ſuch diſpoſitions, it is not to be wondered at that in a few years he ſhould have had a very great influence in the Church; and that the party with which he was connected, ſhould have derived eſſential advantage from his ſteady activity, prudence and popularity. Account of Dr Dryſdale.

IN the year 1773, Dr DRYSDALE's numerous friends thought it due time to raiſe him to the dignity of Moderator of the General Aſſembly, the greateſt mark of reſpect which an eccleſiaſtical commonwealth can beſtow on any of its members; and being accordingly choſen without oppoſition, he diſcharged the duties of the office with great ſatisfaction to the Venerable Court, and credit to himſelf.

AFTER this period, his influence among the miniſters and elders of the Church ſtill continued to increaſe, while he perſevered in ſeizing every opportunity to do all the ſervice in his power, either to the Church in general, or to its members as individuals. When his venerable colleague Dr WISHART began to feel the approaches of old age, and the diſcharge of the duty of clerk to the General Aſſembly was growing burdenſome to him, Dr DRYSDALE was always at hand to aſſiſt and to relieve him; till at laſt, during the Aſſembly 1778, Dr WISHART gave in a repreſentation to the Court, expreſſing his deſire to reſign the clerkſhip, in order that he might be re-elected, in conjunction with another perſon, on whom he might, under the infirmities of age, devolve the laborious part of the duty. Next day, the Aſſembly having conſidered this propoſal, accepted of Dr WISHART's reſignation, and then unanimouſly re-elected him, in conjunction with Dr DRYSDALE, in the way in which he had deſired.

IN the year 1784, it was apprehended, that the choice of a Moderator of the General Aſſembly might occaſion a diſpute betwixt the two great parties in the Church. After deliberation,

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tion, the leaders on the moderate ſide pitched upon Dr DRYSDALE as their candidate, thinking that of all others he was moſt likely to defeat the views of their antagoniſts. But they found great difficulty in prevailing on him to comply with their wiſhes. His modeſty diſpoſed him to decline the honour of the Moderatorſhip a ſecond time, and he was afraid that his conſtitution, which never was robuſt, and now much weaker than when he held that office eleven years before, might not be equal to the fatigues in which he would neceſſarily be involved. Beſides, he was extremely unwilling to put his friends to the trouble of coming from the remote parts of the country on his account. By earneſt ſolicitation, and particularly when it was ſtrongly ſtated to him that he ought not to conſider this as his own cauſe only, but the cauſe of the friends with whom he had always acted, his objections at laſt were removed; and as it was a maxim of his never to do things by halves, he determined to uſe his utmoſt exertions in collecting ſuch a ſupport as might juſtify the favourable opinion that had been formed of him. Accordingly, on the meeting of the Aſſembly, though a moſt reſpectable clergyman was named as the other candidate, Dr DRYSDALE, by a very great majority of votes, was ſeated a ſecond time in the Moderator's chair.

THIS was the laſt great exertion which he made. His friend Dr ROBERTSON had, ſome years before, declined all concern in the public affairs of the Church; ſince which time it was ſuppoſed, that Dr DRYSDALE poſſeſſed more influence among his brethren than any other individual; and this Aſſembly afforded a clear proof of it. No perſon had appeared ſo eloquent, or poſſeſſed of talents ſo fit for a leader in the Aſſembly, as Dr ROBERTSON. But after he withdrew, the conduct of the debates in that houſe ſeemed to be ſhared among a number of ſpeakers; and while the claim of no ſingle perſon was admitted to be the oſtenſible leader, it was well known, that the prudence and the influence of Dr DRYSDALE had the great-

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eſt ſhare in guiding all the meaſures of his party, while he himſelf claimed no merit, and had no pretenſions.

He had been for a long time ſo well acquainted with the ſtate of the two parties in the Church, that he uſed to calculate, with ſurpriſing exactneſs, what the iſſue of the votes would be in almoſt all the great queſtions that came before the Aſſembly. He would often, with that good humour which marked all his converſation, tell his acquaintance of the oppoſite party, by how many votes they would loſe the queſtion; and however ſanguine at firſt they might be, they knew him ſo well, that they ſeldom diſputed his accuracy.

His health was now greatly on the decline. So long before as the end of the year 1773, his conſtitution had received a ſhock, which, though viſible to his own family, did not yet appear to his other friends. Death had deprived him of ſeveral of his children; and being a moſt affectionate parent, he was always extremely affected with the loſs of them: And that year added to his former diſtreſſes the death of his youngeſt daughter, a moſt beautiful and promiſing child. With this he continued to be ſo much affected, that ſeveral years afterwards, when he was inculcating upon his audience the important leſſon, "That man knows not what is good for him in this life;" and was obſerved, in one part of his diſcourſe, to be agitated with uncommon emotion, it was evident to his friends, that he alluded to his own ſituation.

Though his conſtitution continued to be gradually enfeebled, he ſtill diſcharged the public duties of his miniſtry with little intermiſſion; and it was obſerved, that the annual approach of the General Aſſembly always inſpired him with unuſual animation. For ſeveral years, he had taken upon him the whole duty of the clerkſhip, exerting himſelf alſo, in every other reſpect, for the relief of Dr Wishart, his venerable colleague, now far advanced in life, till, in the year 1785, he

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loft that truly refpectable and valuable friend. He preached a fermon on that occafion from the following words: *Let me die the death of the righteous, and let my laft end be like his;* and though, by that time, his powers of compofition, and the energy of his delivery, were much abated, he paid an affectionate tribute to the memory of the much-refpected partner of his labours, whofe character, in defcribing that of the righteous man throughout the firft part of the difcourfe, he plainly alluded to, and in the conclufion delineated in direct terms.

After this time, it was evident, not only to his particular friends, but alfo to his hearers, that the ftrength both of his mind and body was confiderably impaired. The decline of his health was much accelerated by a fevere cough, to which he had long been fubject. He continued, however, occafionally to preach, though his difcourfes wanted that energy, both in compofition and delivery, which ufed to diftinguifh them.

For fome years during the fitting of the General Affemblies, when he felt the difcharge of the duty of Principal-Clerk at times too fatiguing for him, he was allowed to retire, and one of the affiftant clerks officiated in his ftead. At the meeting of the Affembly in May 1788, he appeared in his place, and acted as Principal Clerk the firft day; but finding his ftrength unequal to the remaining parts of the duty, on the fecond day he requefted permiffion of the Court to be affifted by his friend and relation *, who now pays this willing tribute to his memory, and his requeft was unanimoufly granted.

But he did not long furvive the Affembly of that year. Early in the month of June, his cough attacked him with extraordinary violence, and foon weakened him fo much, that he could no longer rife from his bed. He ftill however retained his

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* The hufband of his eldeft daughter.

his wonted endearing manner to his family,—only leſs animated, but affecting in the utmoſt degree. Thus he continued to grow weaker and weaker, until his conſtitution at laſt ſeemed to be quite worn out; and in him the Church of Scotland loſt one of her greateſt ornaments, on the 16th of June 1788.

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SUCH was the concluſion of the well-ſpent life of this excellent perſon; whoſe integrity was inflexible, whoſe amiable converſation and manners were expreſſive of the extreme worth and benevolence of his heart, whoſe reſpectable character adorned his ſacred profeſſion, and who was the delight of his friends and of his family. Though gentle, unſuſpicious and candid, in an extraordinary degree, yet, as his ſoul was inſpired with that noble elevation which ariſes from conſcious virtue and freedom from all deceit, his indignation was excited whenever he detected in others any duplicity in conduct, or any deviation from the road of honour. As in his public appearances, the energy and animation with which he delivered and enforced his inſtructions, carried a conviction that they flowed directly from the heart; ſo it was univerſally allowed by all thoſe who were acquainted with his private life, that never any man more ſucceſsfully illuſtrated what he taught by his own conduct and manners. His charity to the indigent was as extenſive as his circumſtances would admit, and in ſome caſes went far beyond what ordinary men would deem to be conſiſtent with prudence. He took the greateſt pleaſure in protecting, encouraging and bringing forward young men, who ſeemed to him to be poſſeſſed of talents which promiſed to be uſeful in thoſe ſituations which were the objects of their purſuit either in Church or State, and he was indefatigable in availing himſelf of every opportunity to ſerve them. He lived to have the ſatisfaction of ſeeing many of them ſucceſsful in life; but no one ever obſerved him arrogating any merit to himſelf on that account, or even betraying a ſingle expreſſion which might

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ſeem to hint a claim on their gratitude. It is not therefore ſurpriſing that he was ſo much beloved by his younger friends.

BUT Dr DRYSDALE continued alſo to enjoy the affection of the friends of his youth. Mr OSWALD, Dr SMITH and Dr ROBERTSON, have been already mentioned. Though his intercourſe with Dr SMITH had been, in conſequence of the diſtance of their ſituation, leſs frequent for many years than they could have wiſhed, yet they uſed to meet occaſionally in their native town, to which they were always fondly attached; and there, in company with Mr OSWALD, and ſome other companions leſs known to fame, they ſpent many of the moſt pleaſant hours of their life. When afterwards Dr SMITH came to reſide in Edinburgh, they then aſſociated together with leſs interruption; nor was there any one among all the numerous friends and acquaintance of that excellent man whom he loved with greater affection, or ſpoke of with greater tenderneſs, than JOHN DRYSDALE. Two other intimate friends of Dr DRYSDALE's earlier years, and on whom he had ſet a great value, died long before him. Theſe were Mr WILLIAM CLEGHORN and Dr WILLIAM WILKIE; the former of whom was the immediate ſucceſſor of the late Sir JOHN PRINGLE in the Profeſſorſhip of Moral Philoſophy in the Univerſity of Edinburgh, a young man of great genius, and from whom much was expected; but he was cut off in the flower of youth: the latter known to the public as the author of the Epigoniad, and Fables in Verſe, was diſtinguiſhed alſo among a numerous circle of literary friends for extenſive and profound erudition, for a copious and inexhauſtible flow of original, amuſing and inſtructing converſation, and likewiſe for ſome whimſical and diverting peculiarities of character. With the family of the ADAMS, whoſe genius and taſte in the elegant arts of architecture and deſigning, have vied with the talents of the poet, the hiſtorian, and the philoſopher, in reflecting luſtre on their native land, Dr DRYSDALE long lived in a conſtant reciprocation of good offices,

both as the much reſpected relation, and as the intimate friend. His wife MARY ADAM, and two daughters, compoſe his ſurviving family. He has left likewiſe behind him a brother, whom he loved with the moſt ardent affection, GEORGE DRYSDALE, Eſq; formerly Provoſt of Kirkaldy, and now Collector of the cuſtoms in that town, the ſteady and much-eſteemed friend alſo of the late Mr OSWALD and Dr SMITH, and when they viſited the place of their nativity, the companion of their ſocial hours.

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To thoſe who were not intimately acquainted with the ſubject of the foregoing narrative, the language of eulogy may ſeem to have been admitted to too great an extent; and exaggeration of praiſe may be ſuſpected, merely becauſe ſuch virtuous men as the late Dr DRYSDALE are not often to be found. Thoſe, however, who knew him beſt will give their cordial aſſent to what has been ſaid; for in all that has been aſſerted, truth has been aimed at, and the language of panegyric may accord ſometimes with the dictates of truth.

SINCE Dr DRYSDALE's death, two volumes of his ſermons have been publiſhed, which will be a laſting monument of his admirable talents as a Preacher; being, in the opinion of competent judges, compoſitions of the higheſt excellence, and evidently the productions of a mind of a ſuperior order.

III. Ac-

III. Account *of the* Life *and* Writings *of Adam Smith*, LL.D.

[*Read by Mr Stewart, Jan.* 21. *and March* 18. 1793.]

SECTION I.

From Mr Smith's Birth till the Publication of the Theory of Moral Sentiments.

ADAM SMITH, Author of the Inquiry into the Nature and Caufes of the Wealth of Nations, was the fon of Adam Smith, Comptroller of the Cuftoms at Kirkaldy *, and of Margaret Douglas, daughter of Mr Douglas of Strathenry. He was the only child of the marriage, and was born at Kirkaldy on the 5th of June 1723, a few months after the death of his father.

His

* Mr Smith, the father, was a native of Aberdeenfhire, and in the earlier part of his life practifed at Edinburgh as a writer to the Signet. He was afterwards private fecretary to the Earl of Loudoun, (during the time that he held the offices of principal Secretary of State for Scotland, and of Keeper of the Great Seal), and continued in his employment till 1713 or 1714, when he was appointed comptroller of the cuftoms at Kirkaldy. He was alfo clerk to the courts martial and councils of war for Scotland; an office which he held from 1707 till his death. As it is now feventy years fince he died, the accounts I have received of him are very imperfect; but from the particulars already mentioned, it may be prefumed, that he was a man of more than common abilities.

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His conſtitution during infancy was infirm and ſickly, and required all the tender ſolicitude of his ſurviving parent. She was blamed for treating him with an unlimited indulgence; but it produced no unfavourable effects on his temper or his diſpoſitions:—and he enjoyed the rare ſatisfaction of being able to repay her affection, by every attention that filial gratitude could dictate, during the long period of ſixty years.

An accident, which happened to him when he was about three years old, is of too intereſting a nature to be omitted in the account of ſo valuable a life. He had been carried by his mother to Strathenry on a viſit to his uncle Mr Douglas, and was one day amuſing himſelf alone at the door of the houſe, when he was ſtolen by a party of that ſet of vagrants who are known in Scotland by the name of tinkers. Luckily he was ſoon miſſed by his uncle, who hearing that ſome vagrants had paſſed, purſued them, with what aſſiſtance he could find, till he overtook them in Leſlie wood; and was the happy inſtrument of preſerving to the world a genius, which was deſtined, not only to extend the boundaries of ſcience, but to enlighten and reform the commercial policy of Europe.

The ſchool of Kirkaldy, where Mr Smith received the firſt rudiments of his education, was then taught by Mr David Miller, a teacher, in his day, of conſiderable reputation, and whoſe name deſerves to be recorded, on account of the eminent men whom that very obſcure ſeminary produced while under his direction. Mr Oswald of Dunikeir, whoſe profound knowledge of finances raiſed him afterwards to important employments in the State, and to a diſtinguiſhed rank as a Parliamentary ſpeaker; his brother, Dr John Oswald, afterwards Biſhop of Raphoe; and Dr John Drysdale, whoſe talents and worth are well known to this Society, were among the number of Mr Smith's contemporaries.—One of his ſchool-fellows is ſtill alive *; and to his kindneſs I am principally indebted for the

* George Drysdale, Eſq; of Kirkaldy, brother of the late Dr Drysdale.

the ſcanty materials, which form the firſt part of this narrative. Account of Dr Smith.

AMONG theſe companions of his earlieſt years, Mr SMITH ſoon attracted notice, by his paſſion for books, and by the extraordinary powers of his memory. The weakneſs of his bodily conſtitution prevented him from partaking in their more active amuſements; but he was much beloved by them on account of his temper, which, though warm, was to an uncommon degree friendly and generous. Even then he was remarkable for thoſe habits which remained with him through life, of ſpeaking to himſelf when alone, and of *abſence* in company.

FROM the grammar-ſchool of Kirkaldy, he was ſent, in 1737, to the Univerſity of Glaſgow, where he remained till 1740, when he went to Balliol College, Oxford, as an exhibitioner on SNELL's foundation.

Dr MACLAINE of the Hague, who was a fellow-ſtudent of Mr SMITH's at Glaſgow, told me ſome years ago, that his favourite purſuits while at that Univerſity were Mathematics and Natural Philoſophy; and I remember to have heard my father remind him of a geometrical problem of conſiderable difficulty, about which he was occupied at the time when their acquaintance commenced, and which had been propoſed to him as an exerciſe by the celebrated Dr SIMPSON.

THESE, however, were certainly not the ſciences in which he was formed to excel; nor did they long divert him from purſuits more congenial to his mind. What Lord BACON ſays of PLATO may be juſtly applied to him: "Illum, licet ad "rempublicam non acceſſiſſet, tamen naturâ et inclinatione "omnino ad res civiles propenſum, vires eo præcipue intendiſſe; "neque de Philoſophia Naturali admodum ſollicitum eſſe; niſi "quatenus ad Philoſophi nomen et celebritatem tuendam, et "ad majeſtatem quandam moralibus et civilibus doctrinis ad"dendam et aſpergendam ſufficeret*." The ſtudy of human

* Redargutio Philoſophiarum.

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nature in all its branches, more particularly of the political hiſtory of mankind, opened a boundleſs field to his curioſity and ambition; and while it afforded ſcope to all the various powers of his verſatile and comprehenſive genius, gratified his ruling paſſion, of contributing to the happineſs and the improvement of ſociety. To this ſtudy, diverſified at his leiſure hours by the leſs ſevere occupations of polite literature, he ſeems to have devoted himſelf almoſt entirely from the time of his removal to Oxford; but he ſtill retained, and retained even in advanced years, a recollection of his early acquiſitions, which not only added to the ſplendour of his converſation, but enabled him to exemplify ſome of his favourite theories concerning the natural progreſs of the mind in the inveſtigation of truth, by the hiſtory of thoſe ſciences in which the connection and ſucceſſion of diſcoveries may be traced with the greateſt advantage. If I am not miſtaken too, the influence of his early taſte for the Greek geometry may be remarked in the elementary clearneſs and fulneſs, bordering ſometimes upon prolixity, with which he frequently ſtates his political reaſonings.—The lectures of the profound and eloquent Dr Hutcheson, which he had attended previous to his departure from Glaſgow, and of which he always ſpoke in terms of the warmeſt admiration, had, it may be reaſonably preſumed, a conſiderable effect in directing his talents to their proper objects.

I have not been able to collect any information with reſpect to that part of his youth which was ſpent in England. I have heard him ſay, that he employed himſelf frequently in the practice of tranſlation, (particularly from the French), with a view to the improvement of his own ſtyle: and he uſed often to expreſs a favourable opinion of the utility of ſuch exerciſes, to all who cultivate the art of compoſition. It is much to be regretted, that none of his juvenile attempts in this way have been preſerved; as the few ſpecimens which his writings contain of his ſkill as a tranſlator, are ſufficient to ſhew the eminence he had attained in a walk of literature,

which,

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which, in our country, has been ſo little frequented by men of genius.

It was probably alſo at this period of his life, that he cultivated with the greateſt care the ſtudy of languages. The knowledge he poſſeſſed of theſe, both ancient and modern, was uncommonly extenſive and accurate; and, in him, was ſubſervient, not to a vain parade of taſteleſs erudition, but to a familiar acquaintance with every thing that could illuſtrate the inſtitutions, the manners and the ideas of different ages and nations. How intimately he had once been converſant with the more ornamental branches of learning; in particular, with the works of the Roman, Greek, French and Italian poets, appeared ſufficiently from the hold which they kept of his memory, after all the different occupations and enquiries in which his maturer faculties had been employed *. In the Engliſh language, the variety of poetical paſſages which he was not only accuſtomed to refer to occaſionally, but which he was able to repeat with correctneſs, appeared ſurpriſing even to thoſe, whoſe attention had never been directed to more important acquiſitions.

After a reſidence at Oxford of ſeven years, he returned to Kirkaldy, and lived two years with his mother; engaged in ſtudy, but without any fixed plan for his future life. He had been originally deſtined for the Church of England, and with that view had been ſent to Oxford; but not finding the eccleſiaſtical profeſſion ſuitable to his taſte, he choſe to conſult, in this inſtance, his own inclination, in preference to the wiſhes of his friends; and abandoning at once all the ſchemes which

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* The uncommon degree in which Mr Smith retained poſſeſſion, even to the cloſe of his life, of different branches of knowledge which he had long ceaſed to cultivate, has been often remarked to me by my learned colleague and friend, Mr Dalzel, Profeſſor of Greek in this Univerſity.——Mr Dalzel mentioned particularly the readineſs and correctneſs of Mr Smith's memory on philological ſubjects, and the acuteneſs and ſkill he diſplayed in various converſations with him on ſome of the *minutiæ* of Greek grammar.

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their prudence had formed for him, he refolved to return to his own country, and to limit his ambition to the uncertain profpect of obtaining, in time, fome one of thofe moderate preferments, to which literary attainments lead in Scotland.

In the year 1748, he fixed his refidence at Edinburgh, and during that and the following years, read lectures on rhetoric and belles lettres, under the patronage of Lord Kames. About this time, too, he contracted a very intimate friendfhip, which continued, without interruption, till his death, with Mr Alexander Wedderburn, now Lord Loughborough, and with Mr William Johnstone, now Mr Pulteney.

At what particular period his acquaintance with Mr David Hume commenced, does not appear from any information that I have received; but from fome papers, now in the poffeffion of Mr Hume's nephew, and which he has been fo obliging as to allow me to perufe, their acquaintance feems to have grown into friendfhip before the year 1752. It was a friendfhip on both fides founded on the admiration of genius, and the love of fimplicity; and which forms an interefting circumftance in the hiftory of each of thefe eminent men, from the ambition which both have fhewn to record it to pofterity.

In 1751, he was elected Profeffor of Logic in the Univerfity of Glafgow; and, the year following, he was removed to the Profefforfhip of Moral Philofophy in the fame Univerfity, upon the death of Mr Thomas Craigie, the immediate fucceffor of Dr Hutcheson. In this fituation, he remained thirteen years; a period he ufed frequently to look back to, as the moft ufeful and happy of his life. It was indeed a fituation in which he was eminently fitted to excel, and in which the daily labours of his profeffion were conftantly recalling his attention to his favourite purfuits, and familiarifing his mind to thofe important fpeculations he was afterwards to communicate to the world. In this view, though it afforded, in the mean time, but a very narrow fcene for his ambition, it was probably inftrumental, in no inconfiderable degree, to the future eminence of his literary character.

Of

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Of Mr Smith's lectures while a Professor at Glasgow, no part has been preserved, excepting what he himself published in the Theory of Moral Sentiments and in the Wealth of Nations. The Society therefore, I am persuaded, will listen with pleasure to the following short account of them, for which I am indebted to a gentleman who was formerly one of Mr Smith's pupils, and who continued till his death to be one of his most intimate and valued friends.

" In the Professorship of Logic, to which Mr Smith was appointed on his first introduction into this University, he soon saw the necessity of departing widely from the plan that had been followed by his predecessors, and of directing the attention of his pupils to studies of a more interesting and useful nature than the logic and metaphysics of the schools. Accordingly, after exhibiting a general view of the powers of the mind, and explaining so much of the ancient logic as was requisite to gratify curiosity with respect to an artificial method of reasoning, which had once occupied the universal attention of the learned, he dedicated all the rest of his time to the delivery of a system of rhetoric and belles lettres. The best method of explaining and illustrating the various powers of the human mind, the most useful part of metaphysics, arises from an examination of the several ways of communicating our thoughts by speech, and from an attention to the principles of those literary compositions, which contribute to persuasion or entertainment. By these arts, every thing that we perceive or feel, every operation of our minds, is expressed and delineated in such a manner, that it may be clearly distinguished and remembered. There is, at the same time, no branch of literature more suited to youth at their first entrance upon philosophy than this, which lays hold of their taste and their feelings.

" It is much to be regretted, that the manuscript containing Mr Smith's lectures on this subject was destroyed before his death. The first part, in point of composition, was highly finished;

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finiſhed; and the whole diſcovered ſtrong marks of taſte and original genius. From the permiſſion given to ſtudents of taking notes, many obſervations and opinions contained in theſe lectures, have either been detailed in ſeparate diſſertations, or ingroſſed in general collections, which have ſince been given to the public. But theſe, as might be expected, have loſt the air of originality and the diſtinctive character which they received from their firſt author, and are often obſcured by that multiplicity of common-place matter in which they are ſunk and involved.

"About a year after his appointment to the Profeſſorſhip of Logic, Mr Smith was elected to the chair of Moral Philoſophy. His courſe of lectures on this ſubject was divided into four parts. The firſt contained Natural Theology; in which he conſidered the proofs of the being and attributes of God, and thoſe principles of the human mind upon which religion is founded. The ſecond comprehended Ethics ſtrictly ſo called, and conſiſted chiefly of the doctrines which he afterwards publiſhed in his Theory of Moral Sentiments. In the third part, he treated at more length of that branch of morality which relates to *juſtice*, and which, being ſuſceptible of preciſe and accurate rules, is, for that reaſon, capable of a full and particular explanation.

"Upon this ſubject, he followed the plan that ſeems to be ſuggeſted by Montesquieu; endeavouring to trace the gradual progreſs of juriſprudence, both public and private, from the rudeſt to the moſt refined ages, and to point out the effects of thoſe arts which contribute to ſubſiſtence, and to the accumulation of property, in producing correſpondent improvements or alterations in law and government. This important branch of his labours he alſo intended to give to the public; but this intention, which is mentioned in the concluſion of the Theory of Moral Sentiments, he did not live to fulfil.

"In the laſt part of his lectures, he examined thoſe political regulations which are founded, not upon the principle of *juſtice*,

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juſtice, but that of *expediency*, and which are calculated to increaſe the riches, the power and the proſperity of a State. Under this view, he conſidered the political inſtitutions relating to commerce, to finances, to eccleſiaſtical and military eſtabliſhments. What he delivered on theſe ſubjects contained the ſubſtance of the work he afterwards publiſhed under the title of An Inquiry into the Nature and Cauſes of the Wealth of Nations.

"There was no ſituation in which the abilities of Mr Smith appeared to greater advantage than as a Profeſſor. In delivering his lectures, he truſted almoſt entirely to extemporary elocution. His manner, though not graceful, was plain and unaffected; and as he ſeemed to be always intereſted in the ſubject, he never failed to intereſt his hearers. Each diſcourſe conſiſted commonly of ſeveral diſtinct propoſitions, which he ſucceſſively endeavoured to prove and illuſtrate. Theſe propoſitions, when announced in general terms, had, from their extent, not unfrequently ſomething of the air of a paradox. In his attempts to explain them, he often appeared, at firſt, not to be ſufficiently poſſeſſed of the ſubject, and ſpoke with ſome heſitation. As he advanced, however, the matter ſeemed to crowd upon him, his manner became warm and animated, and his expreſſion eaſy and fluent. In points ſuſceptible of controverſy, you could eaſily diſcern, that he ſecretly conceived an oppoſition to his opinions, and that he was led upon this account to ſupport them with greater energy and vehemence. By the fulneſs and variety of his illuſtrations, the ſubject gradually ſwelled in his hands, and acquired a dimenſion which, without a tedious repetition of the ſame views, was calculated to ſeize the attention of his audience, and to afford them pleaſure, as well as inſtruction, in following the ſame object, through all the diverſity of ſhades and aſpects in which it was preſented, and afterwards in tracing it backwards to that ori-

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ginal propofition or general truth, from which this beautiful train of fpeculation had proceeded.

"His reputation as a Profeffor was accordingly raifed very high, and a multitude of ftudents from a great diftance reforted to the Univerfity, merely upon his account. Thofe branches of fcience which he taught became fafhionable at this place, and his opinions were the chief topics of difcuffion in clubs and literary focieties. Even the fmall peculiarities in his pronunciation or manner of fpeaking, became frequently the objects of imitation."

While Mr Smith was thus diftinguifhing himfelf by his zeal and ability as a public teacher, he was gradually laying the foundation of a more extenfive reputation, by preparing for the prefs his fyftem of morals. The firft edition of this work appeared in 1759, under the title of "The Theory of Moral Sentiments."

Hitherto Mr Smith had remained unknown to the world as an author; nor have I heard that he had made a trial of his powers in any anonymous publications, excepting in a periodical work called *The Edinburgh Review*, which was begun in the year 1755, by fome gentlemen of diftinguifhed abilities, but which they were prevented by other engagements from carrying farther than the two firft numbers. To this work Mr Smith contributed a review of Dr Johnson's Dictionary of the Englifh Language, and alfo a letter, addreffed to the editors, containing fome general obfervations on the ftate of literature in the different countries of Europe. In the former of thefe papers, he points out fome defects in Dr Johnson's plan, which he cenfures as not fufficiently grammatical. "The "different fignifications of a word (he obferves) are indeed "collected; but they are feldom digefted into general claffes, "or ranged under the meaning which the word principally ex-"preffes: And fufficient care is not taken to diftinguifh the

3 "words

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"words apparently ſynonymous." To illuſtrate this criticiſm, he copies from Dr JOHNSON the articles BUT and HUMOUR, and oppoſes to them the ſame articles digeſted agreeably to his own idea. The various ſignifications of the word BUT are very nicely and happily diſcriminated. The other article does not ſeem to have been executed with equal care.

THE obſervations on the ſtate of learning in Europe are written with ingenuity and elegance; but are chiefly intereſting, as they ſhew the attention which the Author had given to the philoſophy and literature of the Continent, at a period when they were not much ſtudied in this iſland.

IN the ſame volume with the Theory of Moral Sentiments, Mr SMITH publiſhed a Diſſertation "on the Origin of Languages, and on the different Genius of thoſe which are original and compounded." The remarks I have to offer on theſe two diſcourſes, I ſhall, for the ſake of diſtinctneſs, make the ſubject of a ſeparate ſection.

SECTION II.

Of the Theory of Moral Sentiments, *and the* Diſſertation on the Origin of Languages.

THE ſcience of Ethics has been divided by modern writers into two parts; the one comprehending the theory of Morals, and the other its practical doctrines. The queſtions about which the former is employed, are chiefly the two following. *Firſt*, By what principle of our conſtitution are we led to form the notion of moral diſtinctions;—whether by that faculty which perceives the diſtinction between truth and

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and falſehood; or by a peculiar power of perception, which is *pleaſed* with one ſet of qualities, and *diſpleaſed* with another? *Secondly*, What is the proper object of moral approbation; or, in other words, what is the common quality or qualities belonging to all the different modes of virtue? Is it benevolence; or a rational ſelf-love; or a diſpoſition to act ſuitably to the different relations in which we are placed? Theſe two queſtions ſeem to exhauſt the whole theory of morals. The ſcope of the one is to aſcertain the origin of our moral ideas; that of the other, to refer the phenomena of moral perception to their moſt ſimple and general laws.

The practical doctrines of morality comprehend all thoſe rules of conduct which profeſs to point out the proper ends of human purſuit, and the moſt effectual means of attaining them; to which we may add all thoſe literary compoſitions, whatever be their particular form, which have for their aim to fortify and animate our good diſpoſitions, by delineations of the beauty, of the dignity, or of the utility of Virtue.

I shall not enquire at preſent into the juſtneſs of this diviſion. I ſhall only obſerve, that the words Theory and Practice are not, in this inſtance, employed in their uſual acceptations. The theory of morals does not bear, for example, the ſame relation to the practice of morals, that the theory of geometry bears to practical geometry. In this laſt ſcience, all the practical rules are founded on theoretical principles previouſly eſtabliſhed: But in the former ſcience, the practical rules are obvious to the capacities of all mankind; the theoretical principles form one of the moſt difficult ſubjects of diſcuſſion that have ever exerciſed the ingenuity of metaphyſicians.

In illuſtrating the doctrines of practical morality, (if we make allowance for ſome unfortunate prejudices produced or encouraged by violent and oppreſſive ſyſtems of policy), the ancients ſeem to have availed themſelves of every light furniſhed by nature to human reaſon; and indeed thoſe writers who, in

later

later times, have treated the ſubject with the greateſt ſucceſs, are they who have followed moſt cloſely the footſteps of the Greek and the Roman philoſophers. The theoretical queſtion, too, concerning the eſſence of virtue, or the proper *object* of moral approbation, was a favourite topic of diſcuſſion in the ancient ſchools. The queſtion concerning the *principle* of moral approbation, though not entirely of modern origin, has been chiefly agitated ſince the writings of Dr CUDWORTH, in oppoſition to thoſe of Mr HOBBES ; and it is this queſtion accordingly, (recommended, at once, by its novelty and difficulty to the curioſity of ſpeculative men), that has produced moſt of the theories which characteriſe and diſtinguiſh from each other the later ſyſtems of moral philoſophy.

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IT was the opinion of Dr CUDWORTH and alſo of Dr CLARKE, that moral diſtinctions are perceived by that power of the mind which diſtinguiſhes truth from falſehood. This ſyſtem it was one great object of Dr HUTCHESON's philoſophy to refute, and in oppoſition to it, to ſhew, that the words Right and Wrong expreſs certain agreeable and diſagreeable qualities in actions, which it is not the province of reaſon but of feeling to perceive ; and to that power of perception which renders us ſuſceptible of pleaſure or of pain from the view of virtue or of vice, he gave the name of the Moral Senſe. His reaſonings upon this ſubject are in the main acquieſced in, both by Mr HUME and Mr SMITH ; but they differ from him in one important particular,—Dr HUTCHESON plainly ſuppoſing, that the moral ſenſe is a ſimple principle of our conſtitution, of which no account can be given ; whereas the other two philoſophers have both attempted to analyſe it into other principles more general. Their ſyſtems, however, with reſpect to it are very different from each other. According to Mr HUME, all the qualities which are denominated virtuous, are uſeful either to ourſelves or to others, and the pleaſure which we derive from the view of them is the pleaſure of utility. Mr SMITH, without

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out rejecting entirely Mr HUME's doctrine, propofes another of his own, far more comprehenfive; a doctrine with which he thinks all the moft celebrated theories of morality invented by his predeceffors coincide in part, and from fome partial view of which he apprehends that they have all proceeded.

OF this very ingenious and original theory, I fhall endeavour to give a fhort abftract. To thofe who are familiarly acquainted with it as it is ftated by its Author, I am aware that the attempt may appear fuperfluous; but I flatter myfelf that it will not be wholly ufelefs to fuch as have not been much converfant in thefe abftract difquifitions, by prefenting to them the leading principles of the fyftem in one connected view, without thofe interruptions of the attention which neceffarily arife from the Author's various and happy illuftrations, and from the many eloquent digreffions which animate and adorn his compofition.

THE fundamental principle of Mr SMITH's theory is, that the primary objects of our moral perceptions are the actions of other men; and that our moral judgments with refpect to our own conduct are only applications to ourfelves of decifions which we have already paffed on the conduct of our neighbour. His work accordingly confifts of two parts. In the former, he explains in what manner we learn to judge of the conduct of our neighbour; in the latter, in what manner, by applying thefe judgments to ourfelves, we acquire *a fenfe of duty.*

OUR moral judgments, both with refpect to our own conduct and that of others, include two diftinct perceptions: *firft*, A perception of conduct as right or wrong; and, *fecondly*, A perception of the merit or demerit of the agent. To that quality of conduct which moralifts, in general, exprefs by the word Rectitude, Mr SMITH gives the name of Propriety; and he begins

gins his theory with enquiring in what it conſiſts, and how we are led to form the idea of it. The leading principles of his doctrine on this ſubject are comprehended in the following propoſitions.

1. It is from our own experience alone, that we can form any idea of what paſſes in the mind of another perſon on any particular occaſion; and the only way in which we can form this idea, is by ſuppoſing ourſelves in the ſame circumſtances with him, and conceiving how we ſhould be affected if we were ſo ſituated. It is impoſſible for us, however, to conceive ourſelves placed in any ſituation, whether agreeable or otherwiſe, without feeling an effect of the ſame kind with what would be produced by the ſituation itſelf; and of conſequence the attention we give at any time to the circumſtances of our neighbour, muſt affect us ſomewhat in the ſame manner, although by no means in the ſame degree, as if theſe circumſtances were our own.

That this imaginary change of place with other men, is the real ſource of the intereſt we take in their fortunes, Mr Smith attempts to prove by various inſtances. "When we "ſee a ſtroke aimed, and juſt ready to fall upon the leg or arm "of another perſon, we naturally ſhrink and draw back our "own leg or our own arm; and when it does fall, we feel it "in ſome meaſure, and are hurt by it as well as the ſufferer. "The mob, when they are gazing at a dancer on the ſlack rope, "naturally writhe and twiſt and balance their own bodies, as "they ſee him do, and as they feel that they themſelves muſt "do if in his ſituation." The ſame thing takes place, according to Mr Smith, in every caſe in which our attention is turned to the condition of our neighbour. "Whatever is the paſ"ſion which ariſes from any object in the perſon principally "concerned, an analogous emotion ſprings up, at the thought "of his ſituation, in the breaſt of every attentive ſpectator. "In every paſſion of which the mind of man is ſuſceptible, "the

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" the emotions of the by-ſtander always correſpond to what, " by bringing the caſe home to himſelf, he imagines ſhould be " the ſentiments of the ſufferer."

To this principle of our nature which leads us to enter into the ſituations of other men, and to partake with them in the paſſions which theſe ſituations have a tendency to excite, Mr SMITH gives the name of *ſympathy* or *fellow-feeling*, which two words he employs as ſynonymous. Upon ſome occaſions, he acknowledges, that ſympathy ariſes merely from the view of a certain emotion in another perſon; but in general it ariſes, not ſo much from the view of the emotion, as from that of the ſituation which excites it.

2. A SYMPATHY or fellow-feeling between different perſons is always agreeable to both. When I am in a ſituation which excites any paſſion, it is pleaſant to me to know, that the ſpectators of my ſituation enter with me into all its various circumſtances, and are affected with them in the ſame manner as I am myſelf. On the other hand, it is pleaſant to the ſpectator to obſerve this correſpondence of his emotions with mine.

3. WHEN the ſpectator of another man's ſituation, upon bringing home to himſelf all its various circumſtances, feels himſelf affected in the ſame manner with the perſon principally concerned, he approves of the affection or paſſion of this perſon as juſt and proper and ſuitable to its object. The exceptions which occur to this obſervation are, according to Mr SMITH, only apparent. " A ſtranger, for example, paſſes by " us in the ſtreet with all the marks of the deepeſt affliction; " and we are immediately told, that he has juſt received the " news of the death of his father. It is impoſſible that, in this " caſe, we ſhould not approve of his grief; yet it may often " happen, without any defect of humanity on our part, that, " ſo far from entering into the violence of his ſorrow, we " ſhould ſcarce conceive the firſt movements of concern upon " his account. We have learned, however, from experience,

" that ſuch a misfortune naturally excites ſuch a degree of ſor- Account of Dr Smith,
" row ; and we know, that if we took time to examine his ſi-
" tuation fully and in all its parts, we ſhould, without doubt,
" moſt ſincerely ſympathize with him. It is upon the conſci-
" ouſneſs of this conditional ſympathy that our approbation
" of his ſorrow is founded, even in thoſe caſes in which that
" ſympathy does not actually take place; and the general rules
" derived from our preceding experience of what our ſenti-
" ments would commonly correſpond with, correct upon this,
" as upon many other occaſions, the impropriety of our preſent
" emotions."

By the *propriety* therefore of any affection or paſſion exhibited by another perſon, is to be underſtood its ſuitableneſs to the object which excites it. Of this ſuitableneſs I can judge only from the coincidence of the affection with that which I feel, when I conceive myſelf in the ſame circumſtances; and the perception of this coincidence is the foundation of the ſentiment of *moral approbation*.

4. Although, when we attend to the ſituation of another perſon, and conceive ourſelves to be placed in his circumſtances, an emotion of the ſame kind with that which he feels, naturally ariſes in our own mind, yet this ſympathetic emotion bears but a very ſmall proportion, in point of degree, to what is felt by the perſon principally concerned. In order, therefore, to obtain the pleaſure of mutual ſympathy, nature teaches the ſpectator to ſtrive as much as he can to raiſe his emotion to a level with that which the object would really produce; and, on the other hand, ſhe teaches the perſon whoſe paſſion this object has excited, to bring it down, as much as he can, to a level with that of the ſpectator.

5. Upon theſe two different efforts are founded two different ſets of virtues. Upon the effort of the ſpectator to enter into the ſituation of the perſon principally concerned, and to raiſe his ſympathetic emotions to a level with the emotions of the actor,

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actor, are founded the gentle, the amiable virtues; the virtues of candid condeſcenſion and indulgent humanity. Upon the effort of the perſon principally concerned to lower his own emotions, ſo as to correſpond as nearly as poſſible with thoſe of the ſpectator, are founded the great, the awful and reſpectable virtues; the virtues of ſelf-denial, of ſelf-government, of that command of the paſſions, which ſubjects all the movements of our nature to what our own dignity and honour, and the propriety of our own conduct, require.

As a farther illuſtration of the foregoing doctrine, Mr Smith conſiders particularly the degrees of the different paſſions which are conſiſtent with propriety, and endeavours to ſhew, that in every caſe, it is decent or indecent to expreſs a paſſion ſtrongly, according as mankind are diſpoſed or not diſpoſed to ſympathize with it. It is unbecoming, for example, to expreſs ſtrongly any of thoſe paſſions which ariſe from a certain condition of the body; becauſe other men, who are not in the ſame condition, cannot be expected to ſympathize with them. It is unbecoming to cry out with bodily pain; becauſe the ſympathy felt by the ſpectator bears no proportion to the acuteneſs of what is felt by the ſufferer. The caſe is ſomewhat ſimilar with thoſe paſſions which take their origin from a particular turn or habit of the imagination.

In the caſe of the unſocial paſſions of hatred and reſentment, the ſympathy of the ſpectator is divided between the perſon who feels the paſſion, and the perſon who is the object of it. "We are concerned for both, and our fear for what "the one may ſuffer damps our reſentment for what the other "has ſuffered." Hence the imperfect degree in which we ſympathize with ſuch paſſions; and the propriety, when we are under their influence, of moderating their expreſſion to a much greater degree than is required in the caſe of any other emotions.

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The reverſe of this takes place with reſpect to all the ſocial and benevolent affections. The ſympathy of the ſpectator with the perſon who feels them, coincides with his concern for the perſon who is the object of them. It is this redoubled ſympathy which renders theſe affections ſo peculiarly becoming and agreeable.

The ſelfiſh emotions of grief and joy, when they are conceived on account of our own private good or bad fortune, hold a ſort of middle place between our ſocial and our unſocial paſſions. They are never ſo graceful as the one ſet, nor ſo odious as the other. Even when exceſſive, they are never ſo diſagreeable as exceſſive reſentment; becauſe no oppoſite ſympathy can ever intereſt us againſt them: And when moſt ſuitable to their objects, they are never ſo agreeable as impartial humanity and juſt benevolence; becauſe no double ſympathy can ever intereſt us for them.

After theſe general ſpeculations concerning the propriety of actions, Mr Smith examines how far the judgments of mankind concerning it are liable to be influenced in particular caſes, by the proſperous or the adverſe circumſtances of the agent. The ſcope of his reaſoning on this ſubject is directed to ſhew, (in oppoſition to the common opinion), that when there is no envy in the caſe, our propenſity to ſympathize with joy is much ſtronger than our propenſity to ſympathize with ſorrow; and, of conſequence, that it is more eaſy to obtain the approbation of mankind in proſperity than in adverſity. From the ſame principle he traces the origin of ambition, or of the deſire of rank and pre-eminence; the great object of which paſſion is, to attain that ſituation which ſets a man moſt in the view of general ſympathy and attention, and gives him an eaſy empire over the affections of others.

Having finiſhed the analyſis of our ſenſe of propriety and of impropriety, Mr Smith proceeds to conſider our ſenſe of merit

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and demerit; which he thinks has alſo a reference, in the firſt inſtance, not to our own characters, but to the characters of our neighbours. In explaining the origin of this part of our moral conſtitution, he avails himſelf of the ſame principle of ſympathy, into which he reſolves the ſentiment of moral approbation.

The words *propriety* and *impropriety*, when applied to an affection of the mind, are uſed in this theory (as has been already obſerved) to expreſs the ſuitableneſs or unſuitableneſs of the affection to its exciting *cauſe*. The words *merit* and *demerit* have always a reference (according to Mr Smith) to the *effect* which the affection tends to produce. When the tendency of an affection is beneficial, the agent appears to us a proper object of reward; when it is hurtful, he appears the proper object of puniſhment.

The principles in our nature which moſt directly prompt us to reward and to puniſh, are gratitude and reſentment. To ſay of a perſon, therefore, that he is deſerving of reward or of puniſhment, is to ſay, in other words, that he is a proper object of gratitude or of reſentment; or, which amounts to the ſame thing, that he is to ſome perſon or perſons the object of a gratitude or of a reſentment, which every reaſonable man is ready to adopt and ſympathize with.

It is however very neceſſary to obſerve, that we do not thoroughly ſympathize with the gratitude of one man towards another, merely becauſe this other has been the cauſe of his good fortune, unleſs he has been the cauſe of it from motives which we entirely go along with. Our ſenſe, therefore, of the good deſert of an action, is a compounded ſentiment, made up of an indirect ſympathy with the perſon to whom the action is beneficial, and of a direct ſympathy with the affections and motives of the agent.——The ſame remark applies, *mutatis mutandis*, to our ſenſe of demerit, or of ill-deſert.

From theſe principles it is inferred, that the only actions which appear to us deſerving of reward, are actions of a beneficial

ficial tendency, proceeding from proper motives; the only actions which feem to deferve punifhment, are actions of a hurtful tendency, proceeding from improper motives. A mere want of beneficence expofes to no punifhment; becaufe the mere want of beneficence tends to do no real pofitive evil. A man, on the other hand, who is barely innocent, and contents himfelf with obferving ftrictly the laws of juftice with refpect to others, can merit only that his neighbours, in their turn, fhould obferve religioufly the fame laws with refpect to him.

THESE obfervations lead Mr SMITH to anticipate a little the fubject of the fecond great divifion of his work, by a fhort enquiry into the origin of our fenfe of juftice *as applicable to our own conduct;* and alfo of our fentiments of remorfe, and of good defert.

THE origin of our fenfe of juftice, as well as of all our other moral fentiments, he accounts for by means of the principle of fympathy. When I attend only to the feelings of my own breaft, my own happinefs appears to me of far greater confequence than that of all the world befides. But I am confcious, that in this exceffive preference, other men cannot poffibly fympathize with me, and that to them I appear only one of the crowd, in whom they are no more interefted than in any other individual. If I wifh, therefore, to fecure their fympathy and approbation, (which, according to Mr SMITH, are the objects of the ftrongeft defire of my nature), it is neceffary for me to regard my happinefs, not in that light in which it appears to myfelf, but in that light in which it appears to mankind in general. If an unprovoked injury is offered to me, I know that fociety will fympathize with my refentment; but if I injure the interefts of another, who never injured me, merely becaufe they ftand in the way of my own, I perceive evidently, that fociety will fympathize with *his* refentment, and that I fhall become the object of general indignation.

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WHEN, upon any occaſion, I am led by the violence of paſſion to overlook theſe conſiderations, and, in the caſe of a competition of intereſts, to act according to my own feelings, and not according to thoſe of impartial ſpectators, I never fail to incur the puniſhment of remorſe. When my paſſion is gratified, and I begin to reflect coolly on my conduct, I can no longer enter into the motives from which it proceeded; it appears as improper to me as to the reſt of the world; I lament the effects it has produced; I pity the unhappy ſufferer whom I have injured; and I feel myſelf a juſt object of indignation to mankind. "Such, ſays Mr SMITH, is the nature of that "ſentiment which is properly called remorſe. It is made up "of ſhame from the ſenſe of the impropriety of paſt conduct; "of grief for the effects of it; of pity for thoſe who ſuffer by "it; and of the dread and terror of puniſhment from the "conſciouſneſs of the juſtly provoked reſentment of all ra-"tional creatures."

THE oppoſite behaviour of him who, from proper motives, has performed a generous action, inſpires, in a ſimilar manner, the oppoſite ſentiment of conſcious merit, or of deſerved reward.

THE foregoing obſervations contain a general ſummary of Mr SMITH's principles with reſpect to the origin of our moral ſentiments, in ſo far at leaſt as they relate to the conduct of others. He acknowledges, at the ſame time, that the ſentiments of which we are conſcious, on particular occaſions, do not always coincide with theſe principles; and that they are frequently modified by other conſiderations very different from the propriety or impropriety of the affections of the agent, and alſo from the beneficial or hurtful tendency of theſe affections. The good or the bad conſequences which accidentally follow from an action, and which, as they do not depend on the agent, ought undoubtedly, in point of juſtice, to have no influence on our opinion, either of the propriety or the merit

of

of his conduct, ſcarcely ever fail to influence conſiderably our judgment with reſpect to both; by leading us to form a good or a bad opinion of the prudence with which the action was performed, and by animating our ſenſe of the merit or demerit of his deſign. Theſe facts, however, do not furniſh any objections which are peculiarly applicable to Mr SMITH's theory; for whatever hypotheſis we may adopt with reſpect to the origin of our moral perceptions, all men muſt acknowledge, that in ſo far as the proſperous or the unproſperous event of an action depends on fortune or on accident, it ought neither to increaſe nor to diminiſh our moral approbation or diſapprobation of the agent. And accordingly it has, in all ages of the world, been the complaint of moraliſts, that the actual ſentiments of mankind ſhould ſo often be in oppoſition to this equitable and indiſputable maxim. In examining, therefore, this irregularity of our moral ſentiments, Mr SMITH is to be conſidered, not as obviating an objection peculiar to his own ſyſtem, but as removing a difficulty which is equally connected with every theory on the ſubject which has ever been propoſed. So far as I know, he is the firſt philoſopher who has been fully aware of the importance of the difficulty, and he has indeed treated it with great ability and ſucceſs. The explanation which he gives of it is not warped in the leaſt by any peculiarity in his own ſcheme; and, I muſt own, it appears to me to be the moſt ſolid and valuable improvement he has made in this branch of ſcience. It is impoſſible to give any abſtract of it in a ſketch of this kind; and therefore I muſt content myſelf with remarking, that it conſiſts of three parts. The firſt explains the cauſes of this irregularity of ſentiment; the ſecond, the extent of its influence; and the third, the important purpoſes to which it is ſubſervient. His remarks on the laſt of theſe heads are more particularly ingenious and pleaſing; as their object is to ſhew, in oppoſition to what we ſhould be diſpoſed at firſt to apprehend, that when nature im-

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planted

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planted the seeds of this irregularity in the human breast, her leading intention was, to promote the happiness and perfection of the species.

The remaining part of Mr Smith's theory is employed in shewing, in what manner *our sense of duty* comes to be formed, in consequence of an application to ourselves of the judgments we have previously passed on the conduct of others.

In entering upon this enquiry, which is undoubtedly the most important in the work, and for which the foregoing speculations are, according to Mr Smith's theory, a necessary preparation, he begins with stating *the fact* concerning our consciousness of merited praise or blame; and it must be owned, that the first aspect of the fact, as he himself states it, appears not very favourable to his principles. That the great object of a wise and virtuous man is not to act in such a manner as to obtain the actual approbation of those around him, but to act so as to render himself the *just* and *proper* object of their approbation, and that his satisfaction with his own conduct depends much more on the consciousness of *deserving* this approbation than from that of really enjoying it, he candidly acknowledges; but still he insists, that although this may seem, at first view, to intimate the existence of some moral faculty which is not borrowed from without, our moral sentiments have always some secret reference, either to what are, or to what upon a certain condition would be, or to what we imagine ought to be, the sentiments of others; and that if it were possible, that a human creature could grow up to manhood without any communication with his own species, he could no more think of his own character, or of the propriety or demerit of his own sentiments and conduct, than of the beauty or deformity of his own face. There is indeed a tribunal within the breast, which is the supreme arbiter of all our actions, and

which often mortifies us amidſt the applauſe, and ſupports us under the cenſure of the world; yet ſtill, he contends, that if we enquire into the origin of its inſtitution, we ſhall find, that its juriſdiction is, in a great meaſure, derived from the authority of that very tribunal whoſe deciſions it ſo often and ſo juſtly reverſes.

WHEN we firſt come into the world, we, for ſome time, fondly purſue the impoſſible project of gaining the good-will and approbation of every body. We ſoon however find, that this univerſal approbation is unattainable; that the moſt equitable conduct muſt frequently thwart the intereſts or the inclinations of particular perſons, who will ſeldom have candour enough to enter into the propriety of our motives, or to ſee that this conduct, how diſagreeable ſoever to them, is perfectly ſuitable to our ſituation. In order to defend ourſelves from ſuch partial judgments, we ſoon learn to ſet up in our own minds, a judge between ourſelves and thoſe we live with. We conceive ourſelves as acting in the preſence of a perſon, who has no particular relation, either to ourſelves, or to thoſe whoſe intereſts are affected by our conduct; and we ſtudy to act in ſuch a manner as to obtain the approbation of this ſuppoſed impartial ſpectator. It is only by conſulting him, that we can ſee whatever relates to ourſelves in its proper ſhape and dimenſions.

THERE are two different occaſions, on which we examine our own conduct, and endeavour to view it in the light in which the impartial ſpectator would view it. Firſt, when we are about to act; and, ſecondly, after we have acted. In both caſes, our views are very apt to be partial.

WHEN we are about to act, the eagerneſs of paſſion ſeldom allows us to conſider what we are doing with the candour of an indifferent perſon. When the action is over, and the paſſions which prompted it have ſubſided, although we can undoubtedly enter into the ſentiments of the indifferent ſpectator much

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much more coolly than before, yet it is ſo diſagreeable to us to think ill of ourſelves, that we often purpoſely turn away our view from thoſe circumſtances which might render our judgment unfavourable.—Hence that ſelf-deceit which is the ſource of half the diſorders of human life.

In order to guard ourſelves againſt its deluſions, nature leads us to form inſenſibly, by our continual obſervations upon the conduct of others, certain general rules concerning what is fit and proper either to be done or avoided. Some of their actions ſhock all our natural ſentiments; and when we obſerve other people affected in the ſame manner with ourſelves, we are confirmed in the belief, that our diſapprobation was juſt. We naturally therefore lay it down as a general rule, that all ſuch actions are to be avoided, as tending to render us odious, contemptible or puniſhable; and we endeavour, by habitual reflection, to fix this general rule in our minds, in order to correct the miſrepreſentations of ſelf-love, if we ſhould ever be called on to act in ſimilar circumſtances. The man of furious reſentment, if he was to liſten to the dictates of that paſſion, would perhaps regard the death of his enemy as but a ſmall compenſation for a trifling wrong. But his obſervations on the conduct of others have taught him how horrible ſuch ſanguinary revenges are; and he has impreſſed it on his mind as an invariable rule, to abſtain from them upon all occaſions. This rule preſerves its authority with him, checks the impetuoſity of his paſſion, and corrects the partial views which ſelf-love ſuggeſts; although, if this had been the firſt time in which he conſidered ſuch an action, he would undoubtedly have determined it to be juſt and proper, and what every impartial ſpectator would approve of.—A regard to ſuch general rules of morality conſtitutes, according to Mr Smith, what is properly called *the ſenſe of duty.*

I before hinted, that Mr Smith does not reject entirely from his ſyſtem that principle of *utility*, of which the percep-

tion in any action or character constitutes, according to Mr HUME, the sentiment of moral approbation. That no qualities of the mind are approved of as virtuous, but such as are useful or agreeable, either to the person himself or to others, he admits to be a proposition that holds universally; and he also admits, that the sentiment of approbation with which we regard virtue, is enlivened by the perception of this utility, or, as he explains the fact, it is enlivened by our sympathy with the happiness of those to whom the utility extends: But still he insists, that it is not the view of this utility which is either the first or principal source of moral approbation. Account of Dr Smith.

To sum up the whole of his doctrine in a few words. "When we approve of any character or action, the sentiments "which we feel are derived from four different sources. First, "we sympathize with the motives of the agent; secondly, we "enter into the gratitude of those who receive the benefit of "his actions; thirdly, we observe that his conduct has been "agreeable to the general rules by which those two sympathies "generally act; and, lastly, when we consider such actions as "making a part of a system of behaviour which tends to pro-"mote the happiness, either of the individual or of society, "they appear to derive a beauty from this utility, not un-"like that which we ascribe to any well-contrived machine." These different sentiments, he thinks, exhaust completely, in every instance that can be supposed, the compounded sentiment of moral approbation. "After deducting, says he, in any one "particular case, all that must be acknowledged to proceed "from some one or other of these four principles, I should be "glad to know what remains; and I shall freely allow this "overplus to be ascribed to a moral sense, or to any other pe-"culiar faculty, provided any body will ascertain precisely what "this overplus is."

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Mr Smith's opinion concerning the nature of Virtue, is involved in his Theory concerning the principle of moral approbation. The idea of virtue, he thinks, always implies the idea of propriety, or of the ſuitableneſs of the affection to the object which excites it; which ſuitableneſs, according to him, can be determined in no other way than by the ſympathy of impartial ſpectators with the motives of the agent. But ſtill he apprehends, that this deſcription of virtue is incomplete; for although in every virtuous action propriety is an eſſential ingredient, it is not always the ſole ingredient. Beneficent actions have in them another quality, by which they appear, not only to deſerve approbation, but recompenſe, and excite a ſuperior degree of eſteem, ariſing from a double ſympathy with the motives of the agent, and the gratitude of thoſe who are the objects of his affection. In this reſpect, beneficence appears to him to be diſtinguiſhed from the inferior virtues of prudence, vigilance, circumſpection, temperance, conſtancy, firmneſs, which are always regarded with approbation, but which confer no merit. This diſtinction, he apprehends, has not been ſufficiently attended to by moraliſts; the principles of ſome affording no explanation of the approbation we beſtow on the inferior virtues; and thoſe of others accounting as imperfectly for the peculiar excellency which the ſupreme virtue of beneficence is acknowledged to poſſeſs.

Such are the outlines of Mr Smith's Theory of Moral Sentiments; a work which, whatever opinion we may entertain of the juſtneſs of its concluſions, muſt be allowed by all to be a ſingular effort of invention, ingenuity and ſubtilty. For my own part, I muſt confeſs, that it does not coincide with my notions concerning the foundation of Morals; but I am convinced, at the ſame time, that it contains a large mixture of important truth, and that, although the author has ſometimes been miſled by too great a deſire of generalizing his principles, he has had

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the merit of directing the attention of philofophers to a view of human nature which had formerly, in a great meafure, efcaped their notice. Of the great proportion of juft and found reafoning which the theory involves, its ftriking plaufibility is a fufficient proof; for as the author himfelf has remarked, no fyftem in morals can well gain our affent, if it does not border, in fome refpects, upon the truth. "A fyftem of natural "philofophy, (he obferves), may appear very plaufible, and be "for a long time very generally received in the world, and yet "have no foundation in nature; but the author who fhould "affign as the caufe of any natural fentiment, fome principle "which neither had any connection with it, nor refembled any "other principle which had fome fuch connection, would ap-"pear abfurd and ridiculous to the moft injudicious and un-"experienced reader." The merit, however, of Mr SMITH's performance does not reft here. No work, undoubtedly, can be mentioned, ancient or modern, which exhibits fo complete a view of thofe facts with refpect to our moral perceptions, which it is one great object of this branch of fcience to refer to their general laws; and upon this account, it well deferves the careful ftudy of all whofe tafte leads them to profecute fimilar enquiries. Thefe facts are indeed frequently expreffed in a language which involves the author's peculiar theories: But they are always prefented in the moft happy and beautiful lights; and it is eafy for an attentive reader, by ftripping them of hypothetical terms, to ftate them to himfelf with that logical precifion, which, in fuch very difficult difquifitions, can alone conduct us with certainty to the truth.

IT is proper to obferve farther, that with the theoretical doctrines of the book, there are every where interwoven, with fingular tafte and addrefs, the pureft and moft elevated maxims concerning the practical conduct of life; and that it abounds throughout with interefting and inftructive delineations of characters and manners. A confiderable part of it too is employed

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in collateral enquiries, which, upon every hypothefis that can be formed concerning the foundation of morals, are of equal importance. Of this kind is the fpeculation formerly mentioned, with refpect to the influence of fortune on our moral fentiments, and another fpeculation, no lefs valuable, with refpect to the influence of cuftom and fafhion on the fame part of our conftitution.

THE ftyle in which Mr SMITH has conveyed the fundamental principles on which his theory refts, does not feem to me to be fo perfectly fuited to the fubject as that which he employs on moft other occafions. In communicating ideas which are extremely abftract and fubtile, and about which it is hardly poffible to reafon correctly, without the fcrupulous ufe of appropriated terms, he fometimes prefents to us a choice of words, by no means ftrictly fynonymous, fo as to divert the attention from a precife and fteady conception of his propofition; and a fimilar effect is, in other inftances, produced by that diverfity of forms which, in the courfe of his copious and feducing compofition, the fame truth infenfibly affumes. When the fubject of his work leads him to addrefs the imagination and the heart; the variety and felicity of his illuftrations; the richnefs and fluency of his eloquence; and the fkill with which he wins the attention and commands the paffions of his readers, leave him, among our Englifh moralifts, without a rival.

THE Differtation on the Origin of Languages, which now forms a part of the fame volume with the Theory of Moral Sentiments, was, I believe, firft annexed to the fecond edition of that work. It is an effay of great ingenuity, and on which the author himfelf fet a high value; but, in a general review of

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of his publications, it deferves our attention lefs, on account of the opinions it contains, than as a fpecimen of a particular fort of enquiry, which, fo far as I know, is entirely of modern origin, and which feems, in a peculiar degree, to have interefted Mr SMITH's curiofity. Something very fimilar to it may be traced in all his different works, whether moral, political, or literary; and on all thefe fubjects he has exemplified it with the happieft fuccefs.

WHEN, in fuch a period of fociety as that in which we live, we compare our intellectual acquirements, our opinions, manners, and inftitutions, with thofe which prevail among rude tribes, it cannot fail to occur to us as an interefting queftion, by what gradual fteps the tranfition has been made from the firft fimple efforts of uncultivated nature, to a ftate of things fo wonderfully artificial and complicated. Whence has arifen that fyftematical beauty which we admire in the ftructure of a cultivated language; that analogy which runs through the texture of languages fpoken by the moft remote and unconnected nations; and thofe peculiarities by which they are all diftinguifhed from each other? Whence the origin of the different fciences and of the different arts; and by what chain has the mind been led from their firft rudiments to their laft and moft refined improvements? Whence the aftonifhing fabric of the political union; the fundamental principles which are common to all governments; and the different forms which civilized fociety has affumed in different ages of the world? On moft of thefe fubjects very little information is to be expected from hiftory; for long before that ftage of fociety when men begin to think of recording their tranfactions, many of the moft important fteps of their progrefs have been made. A few infulated facts may perhaps be collected from the cafual obfervations of travellers, who have viewed the arrangements of rude nations; but nothing, it is evident, can be obtained in this way,

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which approaches to a regular and connected detail of human improvement.

In this want of direct evidence, we are under a neceſſity of ſupplying the place of fact by conjecture; and when we are unable to aſcertain how men have actually conducted themſelves upon particular occaſions, of conſidering in what manner they are likely to have proceeded, from the principles of their nature, and the circumſtances of their external ſituation. In ſuch enquiries, the detached facts which travels and voyages afford us, may frequently ſerve as land marks to our ſpeculations; and ſometimes our concluſions *a priori*, may tend to confirm the credibility of facts, which, on a ſuperficial view, appeared to be doubtful or incredible.

Nor are ſuch theoretical views of human affairs ſubſervient merely to the gratification of curioſity. In examining the hiſtory of mankind, as well as in examining the phenomena of the material world, when we cannot trace the proceſs by which an event *has been* produced, it is often of importance to be able to ſhew how it *may have been* produced by natural cauſes. Thus, in the inſtance which has ſuggeſted theſe remarks, although it is impoſſible to determine with certainty what the ſteps were by which any particular language was formed, yet if we can ſhew, from the known principles of human nature, how all its various parts might gradually have ariſen, the mind is not only to a certain degree ſatisfied, but a check is given to that indolent philoſophy, which refers to a miracle, whatever appearances, both in the natural and moral worlds, it is unable to explain.

To this ſpecies of philoſophical inveſtigation, which has no appropriated name in our language, I ſhall take the liberty of giving the title of *Theoretical* or *Conjectural Hiſtory;* an expreſſion which coincides pretty nearly in its meaning with that of *Natural Hiſtory*, as employed by Mr Hume *, and with what ſome French writers have called *Hiſtoire Raiſonée.*

The

* See his Natural Hiſtory of Religion.

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The mathematical ſciences, both pure and mixed, afford, in many of their branches, very favourable ſubjects for theoretical hiſtory; and a very competent judge, the late M. d'Alembert, has recommended this arrangement of their elementary principles, which is founded on the natural ſucceſſion of inventions and diſcoveries, as the beſt adapted for intereſting the curioſity and exerciſing the genius of ſtudents. The ſame author points out as a model a paſſage in Montucla's Hiſtory of Mathematics, where an attempt is made to exhibit the gradual progreſs of philoſophical ſpeculation, from the firſt concluſions ſuggeſted by a general ſurvey of the heavens, to the doctrines of Copernicus. It is ſomewhat remarkable, that a theoretical hiſtory of this very ſcience, (in which we have, perhaps, a better opportunity than in any other inſtance whatever, of comparing the natural advances of the mind with the actual ſucceſſion of hypothetical ſyſtems), was one of Mr Smith's earlieſt compoſitions, and is one of the very ſmall number of his manuſcripts which he did not deſtroy before his death.

I already hinted, that enquiries perfectly analogous to theſe may be applied to the modes of government, and to the municipal inſtitutions which have obtained among different nations. It is but lately, however, that theſe important ſubjects have been conſidered in this point of view; the greater part of politicians before the time of Montesquieu, having contented themſelves with an hiſtorical ſtatement of facts, and with a vague reference of laws to the wiſdom of particular legiſlators, or to accidental circumſtances, which it is now impoſſible to aſcertain. Montesquieu, on the contrary, conſidered laws as originating chiefly from the circumſtances of ſociety; and attempted to account, from the changes in the condition of mankind, which take place in the different ſtages of their progreſs, for the correſponding alterations which their inſtitutions un-

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dergo. It is thus, that in his occaſional elucidations of the Roman juriſprudence, inſtead of bewildering himſelf among the erudition of ſcholiaſts and of antiquaries, we frequently find him borrowing his lights from the moſt remote and unconnected quarters of the globe, and combining the caſual obſervations of illiterate travellers and navigators, into a philoſophical commentary on the hiſtory of law and of manners.

THE advances made in this line of enquiry ſince MONTESQUIEU's time have been great. Lord KAMES, in his Hiſtorical Law Tracts, has given ſome excellent ſpecimens of it, particularly in his Eſſays on the Hiſtory of Property and of Criminal Law, and many ingenious ſpeculations of the ſame kind occur in the works of Mr MILLAR.

IN Mr SMITH's writings, whatever be the nature of his ſubject, he ſeldom miſſes an opportunity of indulging his curioſity, in tracing from the principles of human nature, or from the circumſtances of ſociety, the origin of the opinions and the inſtitutions which he deſcribes. I formerly mentioned a fragment concerning the hiſtory of aſtronomy which he has left for publication; and I have heard him ſay more than once, that he had projected, in the earlier part of his life, a hiſtory of the other ſciences on the ſame plan. In his Wealth of Nations, various diſquiſitions are introduced which have a like object in view; particularly the theoretical delineation he has given of the natural progreſs of opulence in a country; and his inveſtigation of the cauſes which have inverted this order in the different countries of modern Europe. His lectures on juriſprudence ſeem, from the account of them formerly given, to have abounded in ſuch enquiries.

I AM informed by the ſame gentleman who favoured me with the account of Mr SMITH's lectures at Glaſgow, that he had heard him ſometimes hint an intention of writing a treatiſe upon the Greek and Roman republics. "And after all that has been publiſhed on that ſubject, I am convinced, (ſays he), that the

" obſervations of Mr SMITH would have ſuggeſted many new " and important views concerning the internal and domeſtic " circumſtances of thoſe nations, which would have diſplayed " their ſeveral ſyſtems of policy, in a light much leſs artificial " than that in which they have hitherto appeared."

THE ſame turn of thinking was frequently, in his ſocial hours, applied to more familiar ſubjects; and the fanciful theories which, without the leaſt affectation of ingenuity, he was continually ſtarting upon all the common topics of diſcourſe, gave to his converſation a novelty and variety that were quite inexhauſtible. Hence too the minuteneſs and accuracy of his knowledge on many trifling articles, which, in the courſe of his ſpeculations, he had been led to conſider from ſome new and intereſting point of view; and of which his lively and circumſtantial deſcriptions amuſed his friends the more, that he ſeemed to be habitually inattentive, in ſo remarkable a degree, to what was paſſing around him.

I HAVE been led into theſe remarks by the Diſſertation on the Formation of Languages, which exhibits a very beautiful ſpecimen of theoretical hiſtory, applied to a ſubject equally curious and difficult. The analogy between the train of thinking from which it has taken its riſe, and that which has ſuggeſted a variety of his other diſquiſitions, will, I hope, be a ſufficient apology for the length of this digreſſion; more particularly, as it will enable me to ſimplify the account which I am to give afterwards, of his enquiries concerning political œconomy.

I SHALL only obſerve farther on this head, that when different theoretical hiſtories are propoſed by different writers, of the progreſs of the human mind in any one line of exertion, theſe theories are not always to be underſtood as ſtanding in oppoſition to each other. If the progreſs delineated in all of them be plauſible, it is poſſible at leaſt, that they may all have been realized; for human affairs never exhibit, in any two inſtances, a perfect uniformity. But whether they have been realized or no, is often a queſtion of little conſequence. In moſt caſes,

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it is of more importance to aſcertain the progreſs that is moſt ſimple, than the progreſs that is moſt agreeable to fact; for, paradoxical as the propoſition may appear, it is certainly true, that the real progreſs is not always the moſt natural. It may have been determined by particular accidents, which are not likely again to occur, and which cannot be conſidered as forming any part of that general proviſion which nature has made for the improvement of the race.

In order to make ſome amends for the length (I am afraid I may add for the tedioufneſs) of this ſection, I ſhall ſubjoin to it an original letter of Mr Hume's, addreſſed to Mr Smith, ſoon after the publication of his Theory. It is ſtrongly marked with that eaſy and affectionate pleaſantry which diſtinguiſhed Mr Hume's epiſtolary correſpondence, and is entitled to a place in this Memoir, on account of its connection with an important event of Mr Smith's life, which ſoon after removed him into a new ſcene, and influenced, to a conſiderable degree, the ſubſequent courſe of his ſtudies.—The letter is dated from London, 12th April 1759.

" I give you thanks for the agreeable preſent of your Theory. Wedderburn and I made preſents of our copies to ſuch of our acquaintances as we thought good judges, and proper to ſpread the reputation of the book. I ſent one to the Duke of Argyle, to Lord Lyttleton, Horace Walpole, Soame Jennyns, and Burke, an Iriſh Gentleman, who wrote lately a very pretty treatiſe on the Sublime. Millar deſired my permiſſion to ſend one in your name to Dr Warburton. I have delayed writing to you till I could tell you ſomething of the ſucceſs of the book, and could prognoſticate with ſome probability, whether it ſhould be finally damned to oblivion, or

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ſhould be regiſtered in the temple of immortality. Though it has been publiſhed only a few weeks, I think there appear already ſuch ſtrong ſymptoms, that I can almoſt venture to foretel its fate. It is in ſhort this——— But I have been interrupted in my letter by a fooliſh impertinent viſit of one who has lately come from Scotland. He tells me that the Univerſity of Glaſgow intend to declare ROUET's office vacant, upon his going abroad with Lord HOPE. I queſtion not but you will have our friend FERGUSON in your eye, in caſe another project for procuring him a place in the Univerſity of Edinburgh ſhould fail. FERGUSON has very much poliſhed and improved his treatiſe on Refinement *, and with ſome amendments it will make an admirable book, and diſcovers an elegant and a ſingular genius. The Epigoniad, I hope, will do; but it is ſomewhat up-hill work. As I doubt not but you conſult the Reviews ſometimes at preſent, you will ſee in the Critical Review a letter upon that poem; and I deſire you to employ your conjectures in finding out the author. Let me ſee a ſample of your ſkill in knowing hands by your gueſſing at the perſon. I am afraid of Lord KAMES's Law Tracts. A man might as well think of making a fine ſauce by a mixture of wormwood and aloes, as an agreeable compoſition by joining metaphyſics and Scotch law. However, the book, I believe, has merit; though few people will take the pains of diving into it. But, to return to your book, and its ſucceſs in this town, I muſt tell you——— A plague of interruptions! I ordered myſelf to be denied; and yet here is one that has broke in upon me again. He is a man of letters, and we have had a good deal of literary converſation. You told me that you was curious of literary anecdotes, and therefore I ſhall inform you of a few that have come to my knowledge. I believe I have mentioned to you already HELVETIUS's book *de l'Eſprit*. It is worth your reading,

* Publiſhed afterwards under the title of "An Eſſay on the Hiſtory of Civil Society."

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ing, not for its philoſophy, which I do not highly value, but for its agreeable compoſition. I had a letter from him a few days ago, wherein he tells me that my name was much oftener in the manuſcript, but that the Cenſor of books at Paris obliged him to ſtrike it out. VOLTAIRE has lately publiſhed a ſmall work called *Candide, ou l'Optimiſme.* I ſhall give you a detail of it——— But what is all this to my book? ſay you.—My dear Mr SMITH, have patience: Compoſe yourſelf to tranquillity: Shew yourſelf a philoſopher in practice as well as profeſſion: Think on the emptineſs, and raſhneſs, and futility of the common judgments of men: How little they are regulated by reaſon in any ſubject, much more in philoſophical ſubjects, which ſo far exceed the comprehenſion of the vulgar.

——— *Non ſi quid turbida Roma,*
Elevet, accedas: examenve improbum in illa
Caſtiges trutina: nec te quæſiveris extra.

A wiſe man's kingdom is his own breaſt; or, if he ever looks farther, it will only be to the judgment of a ſelect few, who are free from prejudices, and capable of examining his work. Nothing indeed can be a ſtronger preſumption of falſehood than the approbation of the multitude; and PHOCION, you know, always ſuſpected himſelf of ſome blunder, when he was attended with the applauſes of the populace.

"SUPPOSING, therefore, that you have duely prepared yourſelf for the worſt by all theſe reflections, I proceed to tell you the melancholy news, that your book has been very unfortunate; for the public ſeem diſpoſed to applaud it extremely. It was looked for by the fooliſh people with ſome impatience; and the mob of literati are beginning already to be very loud in its praiſes. Three Biſhops called yeſterday at MILLAR's ſhop in order to buy copies, and to aſk queſtions about the author.

The

The Biſhop of PETERBOROUGH ſaid he had paſſed the evening in a company where he heard it extolled above all books in the world. The Duke of ARGYLE is more deciſive than he uſes to be, in its favour. I ſuppoſe he either conſiders it as an exotic, or thinks the author will be ſerviceable to him in the Glaſgow elections. Lord LYTTLETON ſays, that ROBERTSON and SMITH and BOWER are the glories of Engliſh literature. OSWALD proteſts he does not know whether he has reaped more inſtruction or entertainment from it. But you may eaſily judge what reliance can be put on his judgment, who has been engaged all his life in public buſineſs, and who never ſees any faults in his friends. MILLAR exults and brags that two thirds of the edition are already ſold, and that he is now ſure of ſucceſs. You ſee what a ſon of the earth that is, to value books only by the profit they bring him. In that view, I believe it may prove a very good book.

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" CHARLES TOWNSEND, who paſſes for the clevereſt fellow in England, is ſo taken with the performance, that he ſaid to OSWALD he would put the Duke of BUCCLEUGH under the Author's care, and would make it worth his while to accept of that charge. As ſoon as I heard this, I called on him twice, with a view of talking with him about the matter, and of convincing him of the propriety of ſending that young Nobleman to Glaſgow: For I could not hope, that he could offer you any terms which would tempt you to renounce your Profeſſorſhip: But I miſſed him. Mr TOWNSEND paſſes for being a little uncertain in his reſolutions; ſo perhaps you need not build much on this ſally.

" IN recompence for ſo many mortifying things, which nothing but truth could have extorted from me, and which I could eaſily have multiplied to a greater number, I doubt not but you are ſo good a Chriſtian as to return good for evil; and to flatter my vanity by telling me, that all the godly in Scotland

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land abuſe me for my account of JOHN KNOX and the Reformation. I ſuppoſe you are glad to ſee my paper end, and that I am obliged to conclude with

Your Humble Servant,

DAVID HUME."

SECTION III.

From the Publication of The Theory of Moral Sentiments, *till that of* The Wealth of Nations.

AFTER the publication of the Theory of Moral Sentiments, Mr SMITH remained four years at Glaſgow, diſcharging his official duties with unabated vigour, and with increaſing reputation. During that time, the plan of his lectures underwent a conſiderable change. His ethical doctrines, of which he had now publiſhed ſo valuable a part, occupied a much ſmaller portion of the courſe than formerly; and accordingly, his attention was naturally directed to a more complete illuſtration of the principles of juriſprudence and of political œconomy.

To this laſt ſubject, his thoughts appear to have been occaſionally turned from a very early period of life. It is probable, that the uninterrupted friendſhip he had always maintained with his old companion Mr OSWALD*, had ſome tendency to encourage him in proſecuting this branch of his ſtudies; and the

* SINCE the firſt ſection was printed, I find that I have committed a ſlight inaccuracy in mentioning Mr OSWALD and Mr SMITH as ſchool-fellows. The former was born in 1715; the latter in 1723. It appears, however, that their intimacy had commenced before Mr SMITH went to the Univerſity.

the publication of Mr HUME's political difcourfes in the year 1752, could not fail to confirm him in thofe liberal views of commercial policy which had already opened to him in the courfe of his own enquiries. His long refidence in one of the moft enlightened mercantile towns in this ifland, and the habits of intimacy in which he lived with the moft refpectable of its inhabitants, afforded him an opportunity of deriving what commercial information he ftood in need of, from the beft fources; and it is a circumftance no lefs honourable to their liberality than to his talents, that notwithftanding the reluctance fo common among men of bufinefs to liften to the conclufions of mere fpeculation, and the direct oppofition of his leading principles to all the old maxims of trade, he was able, before he quitted his fituation in the Univerfity, to rank fome very eminent merchants in the number of his profelytes *.

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AMONG the ftudents who attended his lectures, and whofe minds were not previoufly warped by prejudice, the progrefs of his opinions, it may be reafonably fuppofed, was much more rapid. It was this clafs of his friends accordingly that firft adopted his fyftem with eagernefs, and diffufed a knowledge of its fundamental principles over this part of the kingdom.

TOWARDS the end of 1763, Mr SMITH received an invitation from Mr CHARLES TOWNSEND to accompany the Duke of BUCCLEUGH on his travels; and the liberal terms in which the propofal was made to him, added to the ftrong defire he had felt of vifiting the Continent of Europe, induced him to refign his office at Glafgow. With the connection which he was led to form in confequence of this change in his fituation, he had reafon to be fatisfied in an uncommon degree, and he always fpoke of it with pleafure and gratitude. To the public, it was not perhaps a change equally fortunate; as it interrupted that ftudious

* I mention this fact on the refpectable authority of JAMES RITCHIE, Efq; of Glafgow.

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ftudious leifure for which nature feems to have deftined him, and in which alone he could have hoped to accomplifh thofe literary projects which had flattered the ambition of his youthful genius.

THE alteration, however, which, from this period, took place in his habits, was not without its advantages. He had hitherto lived chiefly within the walls of an Univerfity; and although to a mind like his, the obfervation of human nature on the fmalleft fcale is fufficient to convey a tolerably juft conception of what paffes on the great theatre of the world, yet it is not to be doubted, that the variety of fcenes through which he afterwards paffed, muft have enriched his mind with many new ideas, and corrected many of thofe mifapprehenfions of life and manners which the beft defcriptions of them can fcarcely fail to convey.—But whatever were the lights that his travels afforded to him as a ftudent of human nature, they were probably ufeful in a ftill greater degree, in enabling him to perfect that fyftem of political œconomy, of which he had already delivered the principles in his lectures at Glafgow, and which it was now the leading object of his ftudies to prepare for the public. The coincidence between fome of thefe principles and the diftingnifhing tenets of the French Oeconomifts, who were at that very time in the height of their reputation, and the intimacy in which he lived with fome of the leaders of that fect, could not fail to affift him in methodizing and digefting his fpeculations; while the valuable collection of facts, accumulated by the zealous induftry of their numerous adherents, furnifhed him with ample materials for illuftrating and confirming his theoretical conclufions.

AFTER leaving Glafgow, Mr SMITH joined the Duke of BUCCLEUGH at London early in the year 1764, and fet out with him for the Continent in the month of March following. At Dover they were met by Sir JAMES MACDONALD, who accompanied them to Paris, and with whom Mr SMITH laid the foun-

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dation of a friendſhip, which he always mentioned with great ſenſibility, and of which he often lamented the ſhort duration. The panegyrics with which the memory of this accompliſhed and amiable perſon has been honoured by ſo many diſtinguiſhed characters in the different countries of Europe, are a proof how well fitted his talents were to command general admiration. The eſteem in which his abilities and learning were held by Mr SMITH, is a teſtimony to his extraordinary merit of ſtill ſuperior value. Mr HUME, too, ſeems, in this inſtance, to have partaken of his friend's enthuſiaſm. "Were you and "I together, (ſays he in a letter to Mr SMITH), we ſhould "ſhed tears at preſent for the death of poor Sir JAMES MAC-"DONALD. We could not poſſibly have ſuffered a greater loſs "than in that valuable young man." Account of Dr Smith.

IN this firſt viſit to Paris, the Duke of BUCCLEUGH and Mr SMITH employed only ten or twelve days *, after which they proceeded

* THE day after his arrival at Paris, Mr SMITH ſent a formal reſignation of his Profeſſorſhip to the Rector of the Univerſity of Glaſgow. "I never was more "anxious (ſays he in the concluſion of this letter) for the good of the College, "than at this moment; and I ſincerely wiſh, that whoever is my ſucceſſor may not "only do credit to the office by his abilities, but be a comfort to the very excel-"lent men with whom he is likely to ſpend his life, by the probity of his heart, "and the goodneſs of his temper."

THE following extract from the records of the Univerſity, which follows immediately after Mr SMITH's letter of reſignation, is at once a teſtimony to his aſſiduity as a Profeſſor, and a proof of the juſt ſenſe which that learned body entertained of the talents and worth of the colleague they had loſt.

"THE Meeting accept of Dr SMITH's reſignation, in terms of the above letter; "and the office of Profeſſor of Moral Philoſophy in this Univerſity is therefore "hereby declared to be vacant. The Univerſity, at the ſame time, cannot help "expreſſing their ſincere regret at the removal of Dr SMITH, whoſe diſtinguiſhed "probity and amiable qualities procured him the eſteem and affection of his col-"leagues; and whoſe uncommon genius, great abilities, and extenſive learning, did "ſo much honour to this ſociety; his elegant and ingenious Theory of Moral Sen-"timents having recommended him to the eſteem of men of taſte and literature

 "throughout

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proceeded to Thoulouſe, where they fixed their reſidence for eighteen months; and where, in addition to the pleaſure of an agreeable ſociety, Mr SMITH had an opportunity of correcting and extending his information concerning the internal policy of France, by the intimacy in which he lived with ſome of the principal perſons of the Parliament.

FROM Thoulouſe they went, by a pretty extenſive tour, through the ſouth of France to Geneva. Here they paſſed two months. The late Earl STANHOPE, for whoſe learning and worth Mr SMITH entertained a ſincere reſpect, was then an inhabitant of that republic.

ABOUT Chriſtmas 1765, they returned to Paris, and remained there till October following. The ſociety in which Mr SMITH ſpent theſe ten months, may be conceived from the advantages he enjoyed, in conſequence of the recommendations of Mr HUME. TURGOT, QUESNAI, NECKER, d'ALEMBERT, HELVETIUS, MARMONTEL, Madame RICCOBONI, were among the number of his acquaintances; and ſome of them he continued ever afterwards to reckon among his friends. From Madame d'ANVILLE, the reſpectable mother of the late excellent and much lamented Duke of ROCHEFOUCAULD *, he received many attentions, which he always recollected with particular gratitude.

IT is much to be regretted, that he preſerved no journal of this very intereſting period of his hiſtory; and ſuch was his averſion

" throughout Europe. His happy talent in illuſtrating abſtracted ſubjects, and " faithful aſſiduity in communicating uſeful knowledge, diſtinguiſhed him as a Pro- " feſſor, and at once afforded the greateſt pleaſure and the moſt important inſtruction " to the youth under his care."

* THE following letter, which has been very accidentally preſerved, while it ſerves as a memorial of Mr SMITH's connection with the family of ROCHEFOUCAULD, is ſo expreſſive of the virtuous and liberal mind of the writer, that I am perſuaded it will give pleaſure to the Society to record it in their Tranſactions.

" *Paris,*

aversion to write letters, that I scarcely suppose any memorial of it exists in his correspondence with his friends. The extent and accuracy of his memory, in which he was equalled by few, made

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" *Paris*, 3. *Mars* 1778.

" Le desir de se rappeller à votre souvenir, Monsieur, quand on a eu l'honneur de vous connoître, doit vous paroître fort naturel; permettez que nous saisissions pour cela, ma Mère et moi, l'occasion d'une édition nouvelle des *Maximes de la Rochefoucauld*, dont nous prenons la liberté de vous offrir un exemplaire. Vous voyez que nous n'avons point de rancune, puisque le mal que vous avez dit de lui dans la *Théorie des Sentimens Moraux*, ne nous empeche point de vous envoier ce même ouvrage. Il s'en est même fallu de peu que je ne fisse encore plus, car j'avois eu peutêtre la témérité d'entreprendre une traduction de votre *Théorie;* mais comme je venois de terminer la premiere partie, j'ai vu paroître la traduction de M. l'Abbé Blavet, et j'ai été forcé de renoncer au plaisir que j'aurois eu de faire passer dans ma langue un des meilleurs ouvrages de la vôtre.

" Il auroit bien fallu pour lors entreprendre une justification de mon grandpère. Peutêtre n'auroit-il pas été difficile, premierement de l'excuser, en disant, qu'il avoit toujours vu les hommes à la Cour, et dans la guerre civile, *deux théatres sur lesquels ils sont certainement plus mauvais qu'ailleurs;* et ensuite de justifier par la conduite personelle de l'auteur, les principes qui sont certainement trop généralisés dans son ouvrage. Il a pris la partie pour le tout; et parceque les gens qu'il avoit eu le plus sous les yeux étoient animés par *l'amour propre*, il en a fait le mobile général de tous les hommes. Au reste, quoique son ouvrage merite à certains égards d'être combattu, il est cependant estimable même pour le fond, et beaucoup pour la forme.

" Permettez moi de vous demander, si nous aurons bientôt une édition complette des œuvres de votre illustre ami M. Hume? Nous l'avons sincèrement regretté.

" Recevez, je vous supplie, l'expression sincère de tous les sentimens d'estime et d'attachement avec lesquels j'ai l'honneur d'être, Monsieur, votre très humble et très obeissant serviteur,

Le Duc de la Rochefoucauld."

Mr Smith's last intercourse with this excellent man was in the year 1789, when he informed him by means of a friend who happened to be then at Paris, that in the future editions of his *Theory* the name of Rochefoucauld should be no

 longer

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made it of little conſequence to himſelf to record in writing what he heard or ſaw; and from his anxiety before his death to deſtroy all the papers in his poſſeſſion, he ſeems to have wiſhed, that no materials ſhould remain for his biographers, but what were furniſhed by the laſting monuments of his genius, and the exemplary worth of his private life.

THE ſatisfaction he enjoyed in the converſation of TURGOT may be eaſily imagined. Their opinions on the moſt eſſential points of political œconomy were the ſame; and they were both animated by the ſame zeal for the beſt intereſts of mankind. The favourite ſtudies, too, of both had directed their enquiries to ſubjects on which the underſtandings of the ableſt and the beſt informed are liable to be warped, to a great degree, by prejudice and paſſion; and on which, of conſequence, a coincidence of judgment is peculiarly gratifying. We are told by one of the biographers of TURGOT, that after his retreat from the miniſtry, he occupied his leiſure in a philoſophical correſpondence with ſome of his old friends; and, in particular, that various letters on important ſubjects paſſed between him and Mr SMITH. I take notice of this anecdote chiefly as a proof of the intimacy which was underſtood to have ſubſiſted between them; for, in other reſpects, the anecdote ſeems to me to be ſomewhat doubtful. It is ſcarcely to be ſuppoſed, that Mr SMITH would deſtroy the letters of ſuch a correſpondent as TURGOT; and ſtill leſs probable, that ſuch an intercourſe was carried on between them without the knowledge of any of Mr SMITH's friends. From ſome enquiries that have been made at Paris by a gentleman

longer claſſed with that of MANDEVILLE. In the enlarged edition accordingly of that work, publiſhed a ſhort time before his death, he has ſuppreſſed his cenſure of the author of the *Maximes*; who ſeems indeed (however exceptionable many of his principles may be) to have been actuated, both in his life and writings, by motives very different from thoſe of MANDEVILLE. The real ſcope of theſe maxims is placed, I think, in a juſt light by the ingenious author of the *notice* prefixed to the edition of them publiſhed at Paris in 1778.

man of this Society ſince Mr SMITH's death, I have reaſon to believe, that no evidence of the correſpondence exiſts among the papers of M. TURGOT, and that the whole ſtory has taken its riſe from a report ſuggeſted by the knowledge of their former intimacy. This circumſtance I think it of importance to mention, becauſe a good deal of curioſity has been excited by the paſſage in queſtion, with reſpect to the fate of the ſuppoſed letters.

Mr SMITH was alſo well known to M. QUESNAI, the profound and original author of the Oeconomical Table; a man (according to Mr SMITH's account of him) "of the greateſt "modeſty and ſimplicity;" and whoſe ſyſtem of political œconomy he has pronounced, "with all its imperfections," to be "the neareſt approximation to the truth that has yet been pu- "bliſhed on the principles of that very important ſcience." If he had not been prevented by QUESNAI's death, Mr SMITH had once an intention (as he told me himſelf) to have inſcribed to him his "Wealth of Nations."

IT was not, however, merely the diſtinguiſhed men who about this period fixed ſo ſplendid an æra in the literary hiſtory of France, that excited Mr SMITH's curioſity while he remained in Paris. His acquaintance with the polite literature both of ancient and modern times was extenſive; and amidſt his various other occupations, he had never neglected to cultivate a taſte for the fine arts;—leſs, it is probable, with a view to the peculiar enjoyments they convey, (though he was by no means without ſenſibility to their beauties), than on account of their connection with the general principles of the human mind; to an examination of which they afford the moſt pleaſing of all avenues. To thoſe who ſpeculate on this very delicate ſubject, a compariſon of the modes of taſte that prevail among different nations, affords a valuable collection of facts; and Mr SMITH, who was always diſpoſed to aſcribe to cuſtom and faſhion their full ſhare in regulating the opinions of mankind

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kind with reſpect to beauty, may naturally be ſuppoſed to have availed himſelf of every opportuuity which a foreign country afforded him of illuſtrating his former theories.

Some of his peculiar notions, too, with reſpect to the imitative arts, ſeem to have been much confirmed by his obſervations while abroad. In accounting for the pleaſure we receive from theſe arts, it had early occurred to him as a fundamental principle, that a very great part of it ariſes from the difficulty of the imitation; a principle which was probably ſuggeſted to him by that of the *difficulté ſurmontée*, by which ſome French critics had attempted to explain the effect of verſification and of rhyme *. This principle Mr Smith puſhed to the greateſt poſſible length, and referred to it, with ſingular ingenuity, a great variety of phenomena in all the different fine arts. It led him, however, to ſome concluſions, which appear, at firſt view at leaſt, not a little paradoxical; and I cannot help thinking, that it warped his judgment in many of the opinions which he was accuſtomed to give on the ſubject of poetry.

The principles of dramatic compoſition had more particularly attracted his attention; and the hiſtory of the theatre, both in ancient and modern times, had furniſhed him with ſome of the moſt remarkable facts on which his theory of the imitative arts was founded. From this theory it ſeemed to follow as a conſequence, that the ſame circumſtances which, in tragedy, give to blank verſe an advantage over proſe, ſhould give to rhyme an advantage over blank verſe; and Mr Smith had always inclined to that opinion. Nay, he had gone ſo far as to extend the ſame doctrine to comedy; and to regret, that thoſe excellent pictures of life and manners which the Engliſh ſtage affords, had not been executed after the model of the French ſchool. The admiration with which he regarded the great dramatic authors of France tended to confirm him in theſe opinions;

* See the Preface to Voltaire's *Oedipe*, Edit. of 1729.

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nions; and this admiration (reſulting originally from the general character of his taſte, which delighted more to remark that pliancy of genius which accommodates itſelf to eſtabliſhed rules, than to wonder at the bolder flights of an undiſciplined imagination) was increaſed to a great degree, when he ſaw the beauties that had ſtruck him in the cloſet, heightened by the utmoſt perfection of theatrical exhibition. In the laſt years of his life, he ſometimes amuſed himſelf, at a leiſure hour, in ſupporting his theoretical concluſions on theſe ſubjects, by the facts which his ſubſequent ſtudies and obſervations had ſuggeſted; and he intended, if he had lived, to have prepared the reſult of theſe labours for the preſs. Of this work he has left for publication a ſhort fragment; the firſt part of which is, in my judgment, more finiſhed in point of ſtyle than any of his compoſitions; but he had not proceeded far enough to apply his doctrine to verſification and to the theatre. As his notions, however, with reſpect to theſe were a favourite topic of his converſation, and were intimately connected with his general principles of criticiſm, it would have been improper to paſs them over in this ſketch of his life; and I even thought it proper to detail them at greater length than the comparative importance of the ſubject would have juſtified, if he had carried his plans into execution. Whether his love of ſyſtem, added to his partiality for the French drama, may not have led him, in this inſtance, to generalize a little too much his concluſions, and to overlook ſome peculiarities in the language and verſification of that country, I ſhall not take upon me to determine.

In October 1766, the Duke of Buccleugh returned to London. His Grace, to whom I am indebted for ſeveral particulars in the foregoing narrative, will, I hope, forgive the liberty I take in tranſcribing one paragraph in his own words: "In "October 1766, we returned to London, after having ſpent "near three years together, without the ſlighteſt diſagreement

"or

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" or coolneſs ;—on my part, with every advantage that could " be expected from the ſociety of ſuch a man. We continued " to live in friendſhip till the hour of his death ; and I ſhall " always remain with the impreſſion of having loſt a friend " whom I loved and reſpected, not only for his great talents, " but for every private virtue."

The retirement in which Mr Smith paſſed his next ten years, formed a ſtriking contraſt to the unſettled mode of life he had been for ſome time accuſtomed to, but was ſo congenial to his natural diſpoſition, and to his firſt habits, that it was with the utmoſt difficulty he was ever perſuaded to leave it. During the whole of this period, (with the exception of a few viſits to Edinburgh and London), he remained with his mother at Kirkaldy ; occupied habitually in intenſe ſtudy, but unbending his mind at times in the company of ſome of his old ſchool-fellows, whoſe " ſober wiſhes" had attached them to the place of their birth. In the ſociety of ſuch men, Mr Smith delighted ; and tothem he was endeared, not only by his ſimple and unaſſuming manners, but by the perfect knowledge they all poſſeſſed of thoſe domeſtic virtues which had diſtinguiſhed him from his infancy.

Mr Hume, who (as he tells us himſelf) conſidered " a town " as the true ſcene for a man of letters," made many attempts to ſeduce him from his retirement. In a letter, dated in 1772, he urges him to paſs ſome time with him in Edinburgh. " I " ſhall not take any excuſe from your ſtate of health, which " I ſuppoſe only a ſubterfuge invented by indolence and love " of ſolitude. Indeed, my dear Smith, if you continue to " hearken to complaints of this nature, you will cut yourſelf " out entirely from human ſociety, to the great loſs of both " parties." In another letter, dated in 1769, from his houſe in James's Court, (which commanded a proſpect of the frith of Forth, and of the oppoſite coaſt of Fife), " I am glad (ſays he) to " have come within ſight of you ; but as I would alſo be with-

" in

"in ſpeaking terms of you, I wiſh we could concert meaſures "for that purpoſe. I am mortally ſick at ſea, and regard with "horror and a kind of hydrophobia the great gulph that lies "between us. I am alſo tired of travelling, as much as you "ought naturally to be of ſtaying at home. I therefore pro- "poſe to you to come hither, and paſs ſome days with me in "this ſolitude. I want to know what you have been doing, "and propoſe to exact a rigorous account of the method in "which you have employed yourſelf during your retreat. I "am poſitive you are in the wrong in many of your ſpecula- "tions, eſpecially where you have the misfortune to differ from "me. All theſe are reaſons for our meeting, and I wiſh you "would make me ſome reaſonable propoſal for that purpoſe. "There is no habitation on the iſland of Inchkeith, otherwiſe "I ſhould challenge you to meet me on that ſpot, and neither "of us ever to leave the place, till we were fully agreed on all "points of controverſy. I expect General CONWAY here to- "morrow, whom I ſhall attend to Roſeneath, and I ſhall re- "main there a few days. On my return, I hope to find a "letter from you, containing a bold acceptance of this de- "fiance."

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AT length (in the beginning of the year 1776) Mr SMITH accounted to the world for his long retreat, by the publication of his "Inquiry into the Nature and Cauſes of the Wealth of Nations." A letter of congratulation on this event, from Mr HUME, is now before me. It is dated 1ſt April 1776, (about ſix months before Mr HUME's death); and diſcovers an amiable ſolicitude about his friend's literary fame. "*Euge! Belle!* "Dear Mr SMITH: I am much pleaſed with your perform- "ance, and the peruſal of it has taken me from a ſtate of "great anxiety. It was a work of ſo much expectation, by "yourſelf, by your friends, and by the public, that I trembled "for its appearance; but am now much relieved. Not but "that the reading of it neceſſarily requires ſo much attention,

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" and the public is difpofed to give fo little, that I fhall ftill " doubt for fome time of its being at firft very popular. But " it has depth and folidity and acutenefs, and is fo much illu- " ftrated by curious facts, that it muft at laft take the public " attention. It is probably much improved by your laft abode " in London. If you were here at my fire-fide, I fhould dif- " pute fome of your principles. . . . . But " thefe, and a hundred other points, are fit only to be difcuf- " fed in converfation. I hope it will be foon; for I am in " a very bad ftate of health, and cannot afford a long de- " lay."

Of a book which is now fo univerfally known as " The Wealth of Nations," it might be confidered perhaps as fuper-fluous to give a particular analyfis; and at any rate, the limits of this effay make it impoffible for me to attempt it at pre-fent. A few remarks, however, on the object and tendency of the work may, I hope, be introduced without impropriety. The hiftory of a Philofopher's life can contain little more than the hiftory of his fpeculations; and in the cafe of fuch an author as Mr Smith, whofe ftudies were fyftematically di-rected from his youth to fubjects of the laft importance to human happinefs, a review of his writings, while it ferves to illuftrate the peculiarities of his genius, affords the moft faith-ful picture of his character as a man.

SECTION

SECTION IV.

Of The Inquiry into the Nature and Causes of the Wealth of Nations *.

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AN hiſtorical review of the different forms under which human affairs have appeared in different ages and nations, naturally ſuggeſts the queſtion, Whether the experience of former times may not now furniſh ſome general principles to enlighten and direct the policy of future legiſlators? The diſcuſſion, however, to which this queſtion leads is of ſingular difficulty; as it requires an accurate analyſis of by far the moſt complicated claſs of phenomena that can poſſibly engage our attention, thoſe which reſult from the intricate and often the imperceptible mechaniſm of political ſociety;—a ſubject of obſervation which ſeems, at firſt view, ſo little commenſurate to our faculties, that it has been generally regarded with the ſame paſſive emotions of wonder and ſubmiſſion, with which, in the material world, we ſurvey the effects produced, by the myſterious and uncontroulable operation of phyſical cauſes. It is fortunate that upon this, as on many other occaſions, the difficulties which had long baffled the efforts of ſolitary genius begin to appear leſs formidable to the united exertions of the race; and that in proportion as the experience and the reaſonings of different individuals are brought to bear upon the ſame objects, and are combined in ſuch a manner as to illuſtrate and to limit each other, the ſcience of politics aſſumes more and more that

(O 2) ſyſtematical

* The length to which this Memoir has already extended, together with ſome other reaſons which it is unneceſſary to mention here, have induced me, in printing the following ſection, to confine myſelf to a much more general view of the ſubject than I once intended.

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ſyſtematical form which encourages and aids the labours of future enquirers.

In proſecuting the ſcience of politics on this plan, little aſſiſtance is to be derived from the ſpeculations of ancient philoſophers, the greater part of whom, in their political enquiries, confined their attention to a compariſon of different forms of government, and to an examination of the proviſions they made for perpetuating their own exiſtence, and for extending the glory of the State. It was reſerved for modern times to inveſtigate thoſe univerſal principles of juſtice and of expediency, which ought, under every form of government, to regulate the ſocial order; and of which the object is, to make as equitable a diſtribution as poſſible, among all the different members of a community, of the advantages ariſing from the political union.

The invention of printing was perhaps neceſſary to prepare the way for theſe reſearches. In thoſe departments of literature and of ſcience, where genius finds within itſelf the materials of its labours; in poetry, in pure geometry, and in ſome branches of moral philoſophy; the ancients have not only laid the foundations on which we are to build, but have left great and finiſhed models for our imitation. But in phyſics, where our progreſs depends on an immenſe collection of facts, and on a combination of the accidental lights daily ſtruck out in the innumerable walks of obſervation and experiment; and in politics, where the materials of our theories are equally ſcattered, and are collected and arranged with ſtill greater difficulty, the means of communication afforded by the preſs have, in the courſe of two centuries, accelerated the progreſs of the human mind, far beyond what the moſt ſanguine hopes of our predeceſſors could have imagined.

The progreſs already made in this ſcience, inconſiderable as it is in compariſon of what may be yet expected, has been ſufficient to ſhew, that the happineſs of mankind depends, not on the

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the ſhare which the people poſſeſſes, directly or indirectly, in the enactment of laws, but on the equity and expediency of the laws that are enacted. The ſhare which the people poſſeſſes in the government is intereſting chiefly to the ſmall number of men whoſe object is the attainment of political importance; but the equity and expediency of the laws are intereſting to every member of the community; and more eſpecially to thoſe, whoſe perſonal inſignificance leaves them no encouragement, but what they derive from the general ſpirit of the government under which they live.

It is evident therefore, that the moſt important branch of political ſcience is that which has for its object to aſcertain the philoſophical principles of juriſprudence; or (as Mr Smith expreſſes it) to aſcertain "the general principles which ought to "run through and be the foundation of the laws of all na-"tions *." In countries, where the prejudices of the people are widely at variance with theſe principles, the political liberty which the conſtitution beſtows, only furniſhes them with the means of accompliſhing their own ruin: And if it were poſſible to ſuppoſe theſe principles completely realized in any ſyſtem of laws, the people would have little reaſon to complain, that they were not immediately inſtrumental in their enactment. The only infallible criterion of the excellence of any conſtitution is to be found in the detail of its municipal code; and the value which wiſe men ſet on political freedom, ariſes chiefly from the facility it is ſuppoſed to afford, for the introduction of thoſe legiſlative improvements which the general intereſts of the community recommend.—I cannot help adding, that the capacity of a people to exerciſe political rights with utility to themſelves and to their country, preſuppoſes a diffuſion of knowledge and of good morals, which can only reſult from the previous operation of laws favourable to induſtry, to order and to freedom.

Of

* See the concluſion of his Theory of Moral Sentiments.

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Of the truth of theſe remarks, enlightened politicians ſeem now to be in general convinced; for the moſt celebrated works which have been produced in the different countries of Europe, during the laſt thirty years, by Smith, Quesnai, Turgot, Campomanes, Beccaria, and others, have aimed at the improvement of ſociety,—not by delineating plans of new conſtitutions, but by enlightening the policy of actual legiſlators. Such ſpeculations, while they are more eſſentially and more extenſively uſeful than any others, have no tendency to unhinge eſtabliſhed inſtitutions, or to inflame the paſſions of the multitude. The improvements they recommend are to be effected by means too gradual and ſlow in their operation, to warm the imaginations of any but of the ſpeculative few; and in proportion as they are adopted, they conſolidate the political fabric, and enlarge the baſis upon which it reſts.

To direct the policy of nations with reſpect to one moſt important claſs of its laws, thoſe which form its ſyſtem of political œconomy, is the great aim of Mr Smith's *Inquiry*: And he has unqueſtionably had the merit of preſenting to the world, the moſt comprehenſive and perfect work that has yet appeared, on the general principles of any branch of legiſlation. The example which he has ſet will be followed, it is to be hoped, in due time, by other writers, for whom the internal policy of ſtates furniſhes many other ſubjects of diſcuſſion no leſs curious and intereſting; and may accelerate the progreſs of that ſcience which Lord Bacon has ſo well deſcribed in the following paſſage: "Finis et ſcopus quem "leges intueri, atque ad quem juſſiones et ſanctiones ſuas "dirigere debent, non alius eſt, quam ut cives feliciter de"gant: id fiet, ſi pietate et religione recte inſtituti; moribus "honeſti; armis adverſus hoſtes externos tuti; legum auxilio "adverſus ſeditiones et privatas injurias muniti; imperio et "magiſtratibus obſequentes; copiis et opibus locupletes et flo"rentes fuerint.——Certe cognitio iſta ad viros civiles proprie

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" ſpectat; qui optime nôrunt, quid ferat ſocietas humana, " quid ſalus populi, quid æquitas naturalis, quid gentium mo- " res, quid rerumpublicarum formæ diverſæ: ideoque poſſint " de legibus, ex principiis et præceptis tam æquitatis naturalis, " quam politices decernere. Quamobrem id nunc agatur, ut " fontes juſtitiæ et utilitatis publicæ petantur, et in ſingulis " juris partibus character quidam et idea juſti exhibeatur, ad " quam particularium regnorum et rerumpublicarum leges " probare, atque inde emendationem moliri, quiſque, cui hoc " cordi erit et curæ, poſſit." The enumeration contained in the foregoing paſſage, of the different objects of law, coincides very nearly with that given by Mr SMITH in the concluſion of his Theory of Moral Sentiments; and the preciſe aim of the political ſpeculations which he then announced, and of which he afterwards publiſhed ſo valuable a part in his Wealth of Nations, was to aſcertain the general principles of juſtice and of expediency, which ought to guide the inſtitutions of legiſlators on theſe important articles;—in the words of Lord BACON, to aſcertain thoſe *leges legum*, " ex quibus informatio peti poſſit, " quid in ſingulis legibus bene aut perperam poſitum aut con- " ſtitutum ſit."

THE branch of legiſlation which Mr SMITH has made choice of as the ſubject of his work, naturally leads me to remark a very ſtriking contraſt between the ſpirit of ancient and of modern policy in reſpect to the wealth of nations *. The great object of the former was to counteract the love of money and a taſte for luxury, by poſitive inſtitutions; and to maintain in the great body of the people, habits of frugality, and a ſeverity of manners. The decline of ſtates is uniformly aſcribed by the philoſophers and hiſtorians, both of Greece and Rome, to the influence of riches on national character; and the laws of LYCURGUS, which, during a courſe of ages, baniſhed the precious metals

* Science de la Legiſlation, par le Chev. FILANGIERI, Liv. i. chap. 13.

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metals from Sparta, are propofed by many of them as the moft perfect model of legiflation devifed by human wifdom.—How oppofite to this is the doctrine of modern politicians! Far from confidering poverty as an advantage to a ftate, their great aim is to open new fources of national opulence, and to animate the activity of all claffes of the people by a tafte for the comforts and accommodations of life.

One principal caufe of this difference between the fpirit of ancient and of modern policy, may be found in the difference between the fources of national wealth in ancient and in modern times. In ages when commerce and manufactures were yet in their infancy, and among ftates conftituted like moft of the ancient republics, a fudden influx of riches from abroad was juftly dreaded as an evil, alarming to the morals, to the induftry, and to the freedom of a people. So different, however, is the cafe at prefent, that the moft wealthy nations are thofe where the people are the moft laborious, and where they enjoy the greateft degree of liberty. Nay, it was the general diffufion of wealth among the lower orders of men, which firft gave birth to the fpirit of independence in modern Europe, and which has produced under fome of its governments, and efpecially under our own, a more equal diffufion of freedom and of happinefs than took place under the moft celebrated conftitutions of antiquity.

Without this diffufion of wealth among the lower orders, the important effects refulting from the invention of printing would have been extremely limited; for a certain degree of eafe and independence is neceffary to infpire men with the defire of knowledge, and to afford them the leifure which is requifite for acquiring it; and it is only by the rewards which fuch a ftate of fociety holds up to induftry and ambition, that the felfifh paffions of the multitude can be interefted in the intellectual improvement of their children. The extenfive pro-

pagation of light and refinement arifing from the influence of the prefs, aided by the fpirit of commerce, feems to be the remedy provided by nature, againft the fatal effects which would otherwife be produced, by the fubdivifion of labour accompanying the progrefs of the mechanical arts: Nor is any thing wanting to make the remedy effectual, but wife inftitutions to facilitate general inftruction, and to adapt the education of individuals to the ftations they are to occupy. The mind of the artift, which, from the limited fphere of his activity, would fink below the level of the peafant or the favage, might receive in infancy the means of intellectual enjoyment, and the feeds of moral improvement; and even the infipid uniformity of his profeffional engagements, by prefenting no object to awaken his ingenuity or to diftract his attention, might leave him at liberty to employ his faculties, on fubjects more interefting to himfelf, and more extenfively ufeful to others.

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These effects, notwithftanding a variety of oppofing caufes which ftill exift, have already refulted, in a very fenfible degree, from the liberal policy of modern times. Mr Hume, in his Effay on Commerce, after taking notice of the numerous armies raifed and maintained by the fmall republics in the ancient world, afcribes the military power of thefe ftates to their want of commerce and luxury. "Few "artifans were maintained by the labour of the farmers, and "therefore more foldiers might live upon it." He adds, however, that "the policy of ancient times was VIOLENT, and con-"trary to the NATURAL courfe of things;"—by which, I prefume, he means, that it aimed too much at modifying, by the force of pofitive inftitutions, the order of fociety, according to fome preconceived idea of expediency; without trufting fufficiently to thofe principles of the human conftitution, which, wherever they are allowed free fcope, not only conduct mankind to happinefs, but lay the foundation of a progreffive im-

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provement in their condition and in their character. The advantages which modern policy possesses over the ancient, arises principally from its conformity, in some of the most important articles of political œconomy, to an order of things recommended by nature; and it would not be difficult to shew, that where it remains imperfect, its errors may be traced to the restraints it imposes on the natural course of human affairs. Indeed, in these restraints may be discovered the latent seeds of many of the prejudices and follies which infect modern manners, and which have so long bid defiance to the reasonings of the philosopher and the ridicule of the satirist.

The foregoing very imperfect hints appeared to me to form, not only a proper, but in some measure a necessary introduction to the few remarks I have to offer on Mr Smith's Inquiry; as they tend to illustrate a connection between his system of commercial politics, and those speculations of his earlier years, in which he aimed more professedly at the advancement of human improvement and happiness. It is this view of political œconomy that can alone render it interesting to the moralist, and can dignify calculations of profit and loss in the eye of the philosopher. Mr Smith has alluded to it in various passages of his work, but he has no where explained himself fully on the subject; and the great stress he has laid on the effects of the division of labour in increasing its productive powers seems, at first sight, to point to a different and very melancholy conclusion;—that the same causes which promote the progress of the arts, tend to degrade the mind of the artist; and, of consequence, that the growth of national wealth implies a sacrifice of the character of the people.

The fundamental doctrines of Mr Smith's system are now so generally known, that it would have been tedious to offer any recapitulation of them in this place; even if I could have hoped to do justice to the subject, within the limits which I have

prescribed

prefcribed to myfelf at prefent. A diftinct analyfis of his work might indeed be ufeful to many readers; but it would itfelf form a volume of confiderable magnitude. I may perhaps, at fome future period, prefent to the Society, an attempt towards fuch an analyfis, which I began long ago, for my own fatisfaction, and which I lately made confiderable progrefs in preparing for the prefs, before I was aware of the impoffibility of connecting it, with the general plan of this paper. In the mean time, I fhall content myfelf with remarking, that the great and leading object of Mr SMITH's fpeculations is to illuftrate the provifion made by nature in the principles of the human mind, and in the circumftances of man's external fituation, for a gradual and progreffive augmentation in the means of national wealth; and to demonftrate, that the moft effectual plan for advancing a people to greatnefs, is to maintain that order of things which nature has pointed out; by allowing every man, as long as he obferves the rules of juftice, to purfue his own intereft in his own way, and to bring both his induftry and his capital into the freeft competition with thofe of his fellow-citizens. Every fyftem of policy which endeavours, either by extraordinary encouragements, to draw towards a particular fpecies of induftry a greater fhare of the capital of the fociety than what would naturally go to it; or, by extraordinary reftraints, to force from a particular fpecies of induftry fome fhare of the capital which would otherwife be employed in it, is, in reality, fubverfive of the great purpofe which it means to promote.

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WHAT the circumftances are, which, in modern Europe, have contributed to difturb this order of nature, and, in particular, to encourage the induftry of towns, at the expence of that of the country, Mr SMITH has inveftigated with great ingenuity; and in fuch a manner, as to throw much new light on the hiftory

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of that ſtate of ſociety which prevails in this quarter of the globe. His obſervations on this ſubject tend to ſhew, that theſe circumſtances were, in their firſt origin, the natural and the unavoidable reſult of the peculiar ſituation of mankind during a certain period; and that they took their riſe, not from any general ſcheme of policy, but from the private intereſts and prejudices of particular orders of men.

The ſtate of ſociety, however, which at firſt aroſe from a ſingular combination of accidents, has been prolonged much beyond its natural period, by a falſe ſyſtem of political œconomy, propagated by merchants and manufacturers; a claſs of individuals, whoſe intereſt is not always the ſame with that of the public, and whoſe profeſſional knowledge gave them many advantages, more particularly in the infancy of this branch of ſcience, in defending thoſe opinions which they wiſhed to encourage. By means of this ſyſtem, a new ſet of obſtacles to the progreſs of national proſperity has been created. Thoſe which aroſe from the diſorders of the feudal ages, tended directly to diſturb the internal arrangements of ſociety, by obſtructing the free circulation of labour and of ſtock, from employment to employment, and from place to place. The falſe ſyſtem of political œconomy which has been hitherto prevalent, as its profeſſed object has been to regulate the commercial intercourſe between different nations, has produced its effect in a way leſs direct and leſs manifeſt, but equally prejudicial to the ſtates that have adopted it.

On this ſyſtem, as it took its riſe from the prejudices, or rather from the intereſted views of mercantile ſpeculators, Mr Smith beſtows the title of the Commercial or Mercantile Syſtem; and he has conſidered at great length its two principal expedients for enriching a nation; reſtraints upon importation, and encouragements to exportation. Part of theſe expedients, he obſerves, have been dictated by the ſpirit of monopoly, and part by

by a ſpirit of jealouſy againſt thoſe countries with which the balance of trade is ſuppoſed to be diſadvantageous. All of them appear clearly, from his reaſonings, to have a tendency unfavourable to the wealth of the nation which impoſes them. —His remarks with reſpect to the jealouſy of commerce are expreſſed in a tone of indignation, which he ſeldom aſſumes in his political writings.

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" In this manner (ſays he) the ſneaking arts of underling " tradeſmen are erected into political maxims for the conduct " of a great empire. By ſuch maxims as theſe, nations have " been taught that their intereſt conſiſted in beggaring all their " neighbours. Each nation has been made to look with an in- " vidious eye upon the proſperity of all the nations with which " it trades, and to conſider their gain as its own loſs. Com- " merce, which ought naturally to be among nations as among " individuals, a bond of union and friendſhip, has become the " moſt fertile ſource of diſcord and animoſity. The capricious " ambition of Kings and Miniſters has not, during the pre- " ſent and the preceding century, been more fatal to the repoſe " of Europe, than the impertinent jealouſy of merchants and " manufacturers. The violence and injuſtice of the rulers of " mankind is an ancient evil, for which perhaps the nature of " human affairs can ſcarce admit of a remedy. But the mean " rapacity, the monopolizing ſpirit of merchants and manu- " facturers, who neither are nor ought to be the rulers of man- " kind, though it cannot perhaps be corrected, may very eaſi- " ly be prevented from diſturbing the tranquillity of any body " but themſelves."

Such are the liberal principles which, according to Mr Smith, ought to direct the commercial policy of nations; and of which it ought to be the great object of legiſlators to facilitate the eſtabliſhment. In what manner the execution of the theory ſhould be conducted in particular inſtances, is a queſtion of a very dif-

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ferent nature, and to which the anſwer muſt vary, in different countries, according to the different circumſtances of the caſe. In a ſpeculative work, ſuch as Mr SMIT 's, the conſideration of this queſtion did not fall properly under his general plan; but that he was abundantly aware of the danger to be apprehended from a raſh application of political theories, appears, not only from the general ſtrain of his writings, but from ſome incidental obſervations which he has expreſsly made upon the ſubject. "So unfortunate (ſays he, in one paſſage) are the "effects of all the regulations of the mercantile ſyſtem, that "they not only introduce very dangerous diſorders into the "ſtate of the body politic, but diſorders which it is often dif-"ficult to remedy, without occaſioning, for a time at leaſt, "ſtill greater diſorders.—In what manner, therefore, the na-"tural ſyſtem of perfect liberty and juſtice ought gradually to "be reſtored, we muſt leave to the wiſdom of future ſtateſmen "and legiſlators to determine." In the laſt edition of his Theory of Moral Sentiments, he has introduced ſome remarks, which have an obvious reference to the ſame important doctrine. The following paſſage ſeems to refer more particularly to thoſe derangements of the ſocial order which derived their origin from the feudal inſtitutions.

"THE man whoſe public ſpirit is prompted altogether by "humanity and benevolence, will reſpect the eſtabliſhed powers "and privileges even of individuals, and ſtill more of the "great orders and ſocieties into which the ſtate is divided. "Though he ſhould conſider ſome of them as in ſome meaſure "abuſive, he will content himſelf with moderating, what he often "cannot annihilate without great violence. When he cannot "conquer the rooted prejudices of the people by reaſon and "perſuaſion, he will not attempt to ſubdue them by force; "but will religiouſly obſerve what, by CICERO, is juſtly called "the divine maxim of PLATO, never to uſe violence to his

"country

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"country no more than to his parents. He will accommodate, "as well as he can, his public arrangements to the confirmed "habits and prejudices of the people; and will remedy, as "well as he can, the inconveniencies which may flow from the "want of thofe regulations which the people are averfe to fub-"mit to. When he cannot eftablifh the right, he will not dif-"dain to ameliorate the wrong; but, like SOLON, when he "cannot eftablifh the beft fyftem of laws, he will endeavour "to eftablifh the beft that the people can bear."

THESE cautions with refpect to the practical application of general principles were peculiarly neceffary from the Author of "The Wealth of Nations;" as the unlimited freedom of trade, which it is the chief aim of his work to recommend, is extremely apt, by flattering the indolence of the ftatefman, to fuggeft to thofe who are invefted with abfolute power, the idea of carrying it into immediate execution. "Nothing is more "adverfe to the tranquillity of a ftatefman (fays the author of "an Eloge on the Adminiftration of COLBERT) than a fpirit of "moderation; becaufe it condemns him to perpetual obferva-"tion, fhews him every moment the infufficiency of his wif-"dom, and leaves him the melancholy fenfe of his own im-"perfection; while, under the fhelter of a few general prin-"ciples, a fyftematical politician enjoys a perpetual calm. By "the help of one alone, that of a perfect liberty of trade, he "would govern the world, and would leave human affairs to "arrange themfelves at pleafure, under the operation of the "prejudices and the felf-intereft of individuals. If thefe run "counter to each other, he gives himfelf no anxiety about the "confequence; he infifts that the refult cannot be judged of "till after a century or two fhall have elapfed. If his contem-"poraries, in confequence of the diforder into which he has "thrown public affairs, are fcrupulous about fubmitting quietly "to the experiment, he accufes them of impatience. They

"alone,

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"alone, and not he, are to blame for what they have ſuffered; "and the principle continues to be inculcated with the ſame "zeal and the ſame confidence as before." Theſe are the words of the ingenious and eloquent author of the Eloge on COLBERT, which obtained the prize from the French Academy in the year 1763; a performance which, although confined and erroneous in its ſpeculative views, abounds with juſt and important reflections of a practical nature. How far his remarks apply to that particular claſs of politicians whom he had evidently in his eye in the foregoing paſſage, I ſhall not preſume to decide.

IT is hardly neceſſary for me to add to theſe obſervations, that they do not detract in the leaſt from the value of thoſe political theories which attempt to delineate the principles of a perfect legiſlation. Such theories (as I have elſewhere obſerved *) ought to be conſidered merely as deſcriptions of the *ultimate* objects at which the ſtateſman ought to aim. The tranquillity of his adminiſtration, and the immediate ſucceſs of his meaſures, depend on his good ſenſe and his practical ſkill; and his theoretical principles only enable him to direct his meaſures ſteadily and wiſely, to promote the improvement and happineſs of mankind, and prevent him from being ever led aſtray from theſe important ends, by more limited views of temporary expedience. "In "all caſes (ſays Mr HUME) it muſt be advantageous to know "what is moſt perfect in the kind, that we may be able to "bring any real conſtitution or form of government as near it "as poſſible, by ſuch gentle alterations and innovations as may "not give too great diſturbance to ſociety."

THE limits of this Memoir make it impoſſible for me to examine particularly the merit of Mr SMITH's work in point of originality. That his doctrine concerning the freedom of trade and

* Elements of the Philoſophy of the Human Mind, p. 261.

and of induſtry coincides remarkably with that which we find in the writings of the French Oeconomiſts, appears from the ſlight view of their ſyſtem which he himſelf has given. But it ſurely cannot be pretended by the warmeſt admirers of that ſyſtem, that any one of its numerous expoſitors has approached to Mr SMITH in the preciſion and perſpicuity with which he has ſtated it, or in the ſcientific and luminous manner in which he has deduced it from elementary principles. The awkwardneſs of their technical language, and the paradoxical form in which they have choſen to preſent ſome of their opinions, are acknowledged even by thoſe who are moſt willing to do juſtice to their merits; whereas it may be doubted with reſpect to Mr SMITH's Inquiry, if there exiſts any book beyond the circle of the mathematical and phyſical ſciences, which is at once ſo agreeable in its arrangement to the rules of a ſound logic, and ſo acceſſible to the examination of ordinary readers. Abſtracting entirely from the author's peculiar and original ſpeculations, I do not know, that upon any ſubject whatever, a work has been produced in our times, containing ſo methodical, ſo comprehenſive and ſo judicious a digeſt of all the moſt profound and enlightened philoſophy of the age.

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IN juſtice alſo to Mr SMITH, it muſt be obſerved, that although ſome of the œconomical writers had the ſtart of him in publiſhing their doctrines to the world, theſe doctrines appear, with reſpect to him, to have been altogether original, and the reſult of his own reflections. Of this, I think, every perſon muſt be convinced, who reads the Inquiry with due attention, and is at pains to examine the gradual and beautiful progreſs of the author's ideas: But in caſe any doubt ſhould remain on this head, it may be proper to mention, that Mr SMITH's political lectures, comprehending the fundamental principles of his Inquiry, were delivered at Glaſgow as early as the year 1752 or 1753; at a period, ſurely, when there exiſted

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no French performance on the ſubject, that could be of much uſe to him in guiding his reſearches *. In the year 1756, indeed, M. TURGOT (who is ſaid to have imbibed his firſt notions concerning the unlimited freedom of commerce from an old merchant, M. GOURNAY) publiſhed in the *Encyclopedie*, an article which ſufficiently ſhews how completely his mind was emancipated from the old prejudices in favour of commercial regulations: But that even then, theſe opinions were confined to a few ſpeculative men in France, appears from a paſſage in the *Mémoires ſur la Vie et les Ouvrages de* M. TURGOT; in which, after a ſhort quotation from the article juſt mentioned, the author adds: "Theſe ideas were *then* conſidered as paradoxical; "they are ſince become common, and they will one day be "adopted univerſally."

THE Political Diſcourſes of Mr HUME were evidently of greater uſe to Mr SMITH, than any other book that had appeared prior to his lectures. Even Mr HUME's theories, however, though always plauſible and ingenious, and in moſt inſtances profound and juſt, involve ſome fundamental miſtakes; and, when compared with Mr SMITH's, afford a ſtriking proof, that, in conſidering a ſubject ſo extenſive and ſo complicated, the moſt penetrating ſagacity, if directed only to particular queſtions, is apt to be led aſtray by firſt appearances; and that nothing can guard us effectually againſt error, but a comprehenſive ſurvey of the whole field of diſcuſſion, aſſiſted by an accurate and patient analyſis of the ideas about which our reaſonings are employed.—It may be worth while to add, that Mr HUME's Eſſay "on the Jealouſy of Trade," with ſome other of his Political Diſcourſes, received a very flattering proof of M.

* In proof of this, it is ſufficient for me to appeal to a ſhort hiſtory of the progreſs of political œconomy in France, publiſhed in one of the volumes of *Ephemerides du Citoyen.* See the firſt part of the volume for the year 1769. The paper is entitled, *Notice abrégée des différents Ecrits modernes, qui ont concouru en France à former la ſcience de l'économie politique.*

M. TURGOT's approbation, by his undertaking the taſk of tranſlating them into the French language. Account of Dr Smith.

I AM aware, that the evidence I have hitherto produced of Mr SMITH's originality may be objected to as not perfectly deciſive, as it reſts entirely on the recollection of thoſe ſtudents who attended his firſt courſes of moral philoſophy at Glaſgow; a recollection which, at the diſtance of forty years, cannot be ſuppoſed to be very accurate. There exiſts however fortunately, a ſhort manuſcript, drawn up by Mr SMITH in the year 1755, and preſented by him to a ſociety of which he was then a member; in which paper, a pretty long enumeration is given of certain leading principles, both political and literary, to which he was anxious to eſtabliſh his excluſive right; in order to prevent the poſſibility of ſome rival claims which he thought he had reaſon to apprehend, and to which his ſituation as a Profeſſor, added to his unreſerved communications in private companies, rendered him peculiarly liable. This paper is at preſent in my poſſeſſion. It is expreſſed with a good deal of that honeſt and indignant warmth, which is perhaps unavoidable by a man who is conſcious of the purity of his own intentions, when he ſuſpects, that advantages have been taken of the frankneſs of his temper. On ſuch occaſions, due allowances are not always made for thoſe plagiariſms which, however cruel in their effects, do not neceſſarily imply bad faith in thoſe who are guilty of them; for the bulk of mankind, incapable themſelves of original thought, are perfectly unable to form a conception of the nature of the injury done to a man of inventive genius, by encroaching on a favourite ſpeculation. For reaſons known to ſome members of this Society, it would be improper, by the publication of this manuſcript, to revive the memory of private differences; and I ſhould not have even alluded to it, if I did not think it a valuable document of the progreſs of Mr SMITH's political ideas at a very early period. Many of the moſt im-

Account of Dr Smith.

portant opinions in *the Wealth of Nations* are there detailed; but I ſhall only quote the following ſentences. "Man "is generally conſidered by ſtateſmen and projectors as the "materials of a ſort of political mechanics. Projectors diſ-"turb nature in the courſe of her operations in human af-"fairs; and it requires no more than to let her alone, and "give her fair play in the purſuit of her ends, that ſhe may "eſtabliſh her own deſigns."—And in another paſſage: "Little "elſe is requiſite to carry a ſtate to the higheſt degree of opu-"lence from the loweſt barbariſm, but peace, eaſy taxes, and "a tolerable adminiſtration of juſtice; all the reſt being "brought about by the natural courſe of things. All govern-"ments which thwart this natural courſe, which force things "into another channel, or which endeavour to arreſt the pro-"greſs of ſociety at a particular point, are unnatural, and to "ſupport themſelves are obliged to be oppreſſive and tyranni-"cal.——A great part of the opinions (he obſerves) enu-"merated in this paper is treated of at length in ſome lec-"tures which I have ſtill by me, and which were written in "the hand of a clerk who left my ſervice ſix years ago. They "have all of them been the conſtant ſubjects of my lectures "ſince I firſt taught Mr CRAIGIE's claſs, the firſt winter I "ſpent in Glaſgow, down to this day, without any conſi-"derable variation. They had all of them been the ſub-"jects of lectures which I read at Edinburgh the winter "before I left it, and I can adduce innumerable witneſſes, both "from that place and from this, who will aſcertain them ſuffi-"ciently to be mine."

AFTER all, perhaps the merit of ſuch a work as Mr SMITH's is to be eſtimated leſs from the novelty of the principles it contains, than from the reaſonings employed to ſupport theſe principles, and from the ſcientific manner in which they are unfolded in their proper order and connection. General aſſertions

tions with reſpect to the advantages of a free commerce, may be collected from various writers of an early date. But in queſtions of ſo complicated a nature as occur in political œconomy, the credit of ſuch opinions belongs of right to the author who firſt eſtabliſhed their ſolidity, and followed them out to their remote conſequences; not to him who, by a fortunate accident, firſt ſtumbled on the truth. Account of Dr Smith.

Besides the principles which Mr Smith conſidered as more peculiarly his own, his Inquiry exhibits a ſyſtematical view of the moſt important articles of political œconomy, ſo as to ſerve the purpoſe of an elementary treatiſe on that very extenſive and difficult ſcience. The ſkill and the comprehenſiveneſs of mind diſplayed in his arrangement, can be judged of by thoſe alone who have compared it with that adopted by his immediate predeceſſors. And perhaps, in point of utility, the labour he has employed in connecting and methodiſing their ſcattered ideas, is not leſs valuable than the reſults of his own original ſpeculations: For it is only when digeſted in a clear and natural order, that truths make their proper impreſſion on the mind, and that erroneous opinions can be combated with ſucceſs.

It does not belong to my preſent undertaking (even if I were qualified for ſuch a taſk) to attempt a ſeparation of the ſolid and important doctrines of Mr Smith's book from thoſe opinions which appear exceptionable or doubtful. I acknowledge, that there are ſome of his concluſions to which I would not be underſtood to ſubſcribe implicitly; more particularly in that chapter, where he treats of the principles of taxation, and which is certainly executed in a manner more looſe and unſatisfactory than the other parts of his ſyſtem.

It would be improper for me to conclude this ſection without taking notice of the manly and dignified freedom with which the author uniformly delivers his opinions, and of the

Account of Dr Smith.

ſuperiority which he diſcovers throughout, to all the little paſſions connected with the factions of the times in which he wrote. Whoever takes the trouble to compare the general tone of his compoſition with the period of its firſt publication, cannot fail to feel and acknowledge the force of this remark.—— It is not often that a diſintereſted zeal for truth has ſo ſoon met with its juſt reward. Philoſophers (to uſe an expreſſion of Lord BACON's) are "the ſervants of poſterity;" and moſt of thoſe who have devoted their talents to the beſt intereſts of mankind, have been obliged, like BACON, to "bequeath their fame" to a race yet unborn, and to conſole themſelves with the idea of ſowing what another generation was to reap:

Inſere Daphni pyros, carpent tua poma nepotes.

Mr SMITH was more fortunate; or rather, in this reſpect, his fortune was ſingular. He ſurvived the publication of his work only fifteen years; and yet, during that ſhort period, he had not only the ſatisfaction of ſeeing the oppoſition it at firſt excited, gradually ſubſide, but to witneſs the practical influence of his writings on the commercial policy of his country.

SECTION

SECTION V.

Conclufion of the Narrative.

Account of Dr Smith.

ABOUT two years after the publication of "the Wealth of Nations," Mr SMITH was appointed one of the Commiffioners of his Majefty's Cuftoms in Scotland; a preferment which, in his eftimation, derived an additional value from its being beftowed on him at the requeft of the Duke of BUCCLEUGH. The greater part of thefe two years he paffed at London, in a fociety too extenfive and varied to afford him any opportunity of indulging his tafte for ftudy. His time, however, was not loft to himfelf; for much of it was fpent with fome of the firft names in Englifh literature. Of thefe no unfavourable fpecimen is preferved by Dr BARNARD, in his well known "Verfes, addreffed to Sir JOSHUA REYNOLDS and his friends."

> If I have thoughts, and can't exprefs 'em,
> GIBBON fhall teach me how to drefs 'em
> In words felect and terfe:
> JONES teach me modefty and Greek,
> SMITH how to think, BURKE how to fpeak,
> And BEAUCLERC to converfe *.

IN confequence of Mr SMITH's appointment to the Board of Cuftoms, he removed, in 1778, to Edinburgh, where he fpent the laft twelve years of his life; enjoying an affluence which was more than equal to all his wants; and, what was to him of ftill greater value, the profpect of paffing the remainder of his days among the companions of his youth.

HIS mother, who, though now in extreme old age, ftill poffeffed a confiderable degree of health, and retained all her faculties unimpaired, accompanied him to town; and his coufin Mifs

* See Annual Regifter for the year 1776.

Account of Dr Smith.

Miſs Jane Douglas, (who had formerly been a member of his family at Glaſgow, and for whom he had always felt the affection of a brother), while ſhe divided with him thoſe tender attentions which her aunt's infirmities required, relieved him of a charge for which he was peculiarly ill qualified, by her friendly ſuperintendence of his domeſtic œconomy.

The acceſſion to his income which his new office brought him enabled him to gratify, to a much greater extent than his former circumſtances admitted of, the natural generoſity of his diſpoſition; and the ſtate of his funds at the time of his death, compared with his very moderate eſtabliſhment, confirmed, beyond a doubt, what his intimate acquaintances had often ſuſpected, that a large proportion of his annual ſavings was allotted to offices of ſecret charity. A ſmall, but excellent library, which he had gradually formed with great judgment in the ſelection; and a ſimple, though hoſpitable table, where, without the formality of an invitation, he was always happy to receive his friends, were the only expences that could be conſidered as his own *.

The change in his habits which his removal to Edinburgh produced, was not equally favourable to his literary purſuits. The duties of his office, though they required but little exertion of thought, were yet ſufficient to waſte his ſpirits and to diſſipate his attention; and now that his career is cloſed, it is impoſſible to reflect on the time they conſumed, without lamenting that it had not been employed in labours more profitable to the world, and more equal to his mind.

During the firſt years of his reſidence in this city, his ſtudies ſeemed to be entirely ſuſpended; and his paſſion for letters

* Some very affecting inſtances of Mr Smith's beneficence, in caſes where he found it impoſſible to conceal entirely his good offices, have been mentioned to me by a near relation of his, and one of his moſt confidential friends, Miſs Ross, daughter of the late Patrick Ross, Eſq; of Innernethy. They were all on a ſcale much beyond what might have been expected from his fortune; and were accompanied with circumſtances equally honourable to the delicacy of his feelings and the liberality of his heart.

Account of Dr Smith.

ters ſerved only to amuſe his leiſure, and to animate his converſation. The infirmities of age, of which he very early began to feel the approaches, reminded him at laſt, when it was too late, of what he yet owed to the public, and to his own fame. The principal materials of the works which he had announced, had been long ago collected; and little probably was wanting, but a few years of health and retirement, to beſtow on them that ſyſtematical arrangement in which he delighted; and the ornaments of that flowing, and apparently artleſs ſtyle, which he had ſtudiouſly cultivated, but which, after all his experience in compoſition, he adjuſted, with extreme difficulty, to his own taſte *.

THE death of his mother in 1784, which was followed by that of Miſs DOUGLAS in 1788, contributed, it is probable, to fruſtrate theſe projects. They had been the objects of his affection for more than ſixty years; and in their ſociety he had enjoyed, from his infancy, all that he ever knew of the endearments of a family. He was now alone, and helpleſs; and, though he bore his loſs with equanimity, and regained apparently his former cheerfulneſs, yet his health and ſtrength gradually declined till the period of his death, which happened in July 1790, about two years after that of his couſin, and ſix after that of his mother. His laſt illneſs, which aroſe from a

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* Mr SMITH obſerved to me, not long before his death, that after all his practice in writing, he compoſed as ſlowly, and with as great difficulty, as at firſt. He added, at the ſame time, that Mr HUME had acquired ſo great a facility in this reſpect, that the laſt volumes of his Hiſtory were printed from his original copy, with a few marginal corrections.

IT may gratify the curioſity of ſome readers to know, that when Mr SMITH was employed in compoſition, he generally walked up and down his apartment, dictating to a ſecretary. All Mr HUME's works (I have been aſſured) were written with his own hand. A critical reader may, I think, perceive in the different ſtyles of theſe two claſſical writers, the effects of their different modes of ſtudy.

Account of Dr Smith.

chronic obſtruction in his bowels, was lingering and painful; but had every conſolation to ſooth it which he could derive from the tendereſt ſympathy of his friends, and from the complete reſignation of his own mind.

A FEW days before his death, finding his end approach rapidly, he gave orders to deſtroy all his manuſcripts, excepting ſome detached eſſays, which he entruſted to the care of his executors; and they were accordingly committed to the flames. What were the particular contents of theſe papers, is not known even to his moſt intimate friends; but there can be no doubt that they conſiſted, in part, of the lectures on rhetoric, which he read at Edinburgh in the year 1748, and of the lectures on natural religion and on juriſprudence, which formed part of his courſe at Glaſgow. That this irreparable injury to letters proceeded, in ſome degree, from an exceſſive ſolicitude in the author about his poſthumous reputation, may perhaps be true; but with reſpect to ſome of his manuſcripts, may we not ſuppoſe, that he was influenced by higher motives? It is but ſeldom that a philoſopher, who has been occupied from his youth with moral or with political enquiries, ſucceeds completely to his wiſh in ſtating to others, the grounds upon which his own opinions are founded; and hence it is, that the known principles of an individual, who has approved to the public his candour, his liberality, and his judgment, are entitled to a weight and an authority, independent of the evidence which he is able, upon any particular occaſion, to produce in their ſupport. A ſecret conſciouſneſs of this circumſtance, and an apprehenſion, that by not doing juſtice to an important argument, the progreſs of truth may be rather retarded than advanced, have probably induced many authors to with-hold from the world the unfiniſhed reſults of their moſt valuable labours; and to content themſelves with giving the general ſanction of their ſuf-

ſrages to truths which they regarded as peculiarly intereſting to the human race *.

Account of Dr Smith.

The additions to the Theory of Moral Sentiments, moſt of which were compoſed under ſevere diſeaſe, had fortunately been ſent to the preſs in the beginning of the preceding winter; and the author lived to ſee the publication of the work. The moral and ſerious ſtrain that prevails through theſe additions, when connected with the circumſtance of his declining health, adds a peculiar charm to his pathetic eloquence; and communicates a new intereſt, if poſſible, to thoſe ſublime truths, which, in the academical retirement of his youth, awakened the firſt ardours of his genius, and on which the laſt efforts of his mind repoſed.

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* Since writing the above, I have been favoured by Dr Hutton with the following particulars.

" Some time before his laſt illneſs, when Mr Smith had occaſion to go to London, he enjoined his friends, to whom he had entruſted the diſpoſal of his manuſcripts, that in the event of his death, they ſhould deſtroy all the volumes of his lectures, doing with the reſt of his manuſcripts what they pleaſed. When now he had become weak, and ſaw the approaching period of his life, he ſpoke to his friends again upon the ſame ſubject. They entreated him to make his mind eaſy, as he might depend upon their fulfilling his deſire. He was then ſatisfied. But ſome days afterwards, finding his anxiety not entirely removed, he begged one of them to deſtroy the volumes immediately. This accordingly was done; and his mind was ſo much relieved, that he was able to receive his friends in the evening with his uſual complacency.

" They had been in uſe to ſup with him every Sunday; and that evening there was a pretty numerous meeting of them. Mr Smith not finding himſelf able to ſit up with them as uſual, retired to bed before ſupper; and, as he went away, took leave of his friends by ſaying, " I believe we muſt adjourn this meeting to ſome other place." He died a very few days afterwards."

Mr Riddell, an intimate friend of Mr Smith's, who was preſent at one of the converſations on the ſubject of the manuſcripts, mentioned to me, in addition to Dr Hutton's note, that Mr Smith regretted, " he had done ſo little." " But I meant (ſaid he) to have done more; and there are materials in my papers, of which I could have made a great deal. But that is now out of the queſtion."

That

Account of Dr Smith.

In a letter addreffed, in the year 1787, to the Principal of the Univerfity of Glafgow, in confequence of his being elected Rector of that learned body, a pleafing memorial remains of the fatisfaction with which he always recollected that period of his literary career, which had been more peculiarly confecrated to thefe important ftudies. "No preferment (fays he) could have "given me fo much real fatisfaction. No man can owe greater "obligations to a fociety than I do to the Univerfity of Glaf-"gow. They educated me; they fent me to Oxford. Soon "after my return to Scotland, they elected me one of their "own members; and afterwards preferred me to another of-"fice, to which the abilities and virtues of the never to be for-"gotten Dr Hutcheson had given a fuperior degree of illu-"ftration.

That the idea of deftroying fuch unfinifhed works as might be in his poffeffion at the time of his death, was not the effect of any fudden or hafty refolution, appears from the following letter to Mr Hume, written by Mr Smith in 1773, at a time when he was preparing himfelf for a journey to London, with the profpect of a pretty long abfence from Scotland.

My dear friend, *Edinburgh, 16th April* 1773.

As I have left the care of all my literary papers to you, I muft tell you, that except thofe which I carry along with me, there are none worth the publication, but a fragment of a great work, which contains a hiftory of the aftronomical fyftems that were fucceffively in fafhion down to the time of Des Cartes. Whether that might not be publifhed as a fragment of an intended juvenile work, I leave entirely to your judgment, though I begin to fufpect myfelf that there is more refinement than folidity in fome parts of it. This little work you will find in a thin folio paper book in my back room. All the other loofe papers which you will find in that defk, or within the glafs folding doors of a bureau which ftands in my bedroom, together with about eighteen thin paper folio books, which you will likewife find within the fame glafs folding doors, I defire may be deftroyed without any examination. Unlefs I die very fuddenly, I fhall take care that the papers I carry with me fhall be carefully fent to you.

I ever am, my dear Friend, moft faithfully your's,

Adam Smith.

To David Hume, Efq;
St Andrew's Square.

"ſtration. The period of thirteen years which I ſpent as a "member of that ſociety, I remember as by far the moſt uſe-"ful, and therefore, as by far the happieſt and moſt honourable "period of my life; and now, after three and twenty years "abſence, to be remembered in ſo very agreeable a manner by "my old friends and protectors, gives me a heart-felt joy "which I cannot eaſily expreſs to you."

THE ſhort narrative which I have now finiſhed, however barren of incident, may convey a general idea of the genius and character of this illuſtrious Man. Of the intellectual gifts and attainments by which he was ſo eminently diſtinguiſhed;—of the originality and comprehenſiveneſs of his views; the extent, the variety and the correctneſs of his information; the inexhauſtible fertility of his invention; and the ornaments which his rich and beautiful imagination had borrowed from claſſical culture;—he has left behind him laſting monuments. To his private worth the moſt certain of all teſtimonies may be found in that confidence, reſpect and attachment, which followed him through all the various relations of life. The ſerenity and gaiety he enjoyed, under the preſſure of his growing infirmities, and the warm intereſt he felt to the laſt, in every thing connected with the welfare of his friends, will be long remembered by a ſmall circle, with whom, as long as his ſtrength permitted, he regularly ſpent an evening in the week; and to whom the recollection of his worth ſtill forms a pleaſing, though melancholy bond of union.

THE more delicate and characteriſtical features of his mind, it is perhaps impoſſible to trace. That there were many peculiarities, both in his manners, and in his intellectual habits, was manifeſt to the moſt ſuperficial obſerver; but, although to thoſe who knew him, theſe peculiarities detracted nothing from the

reſpect

Account of Dr Smith.

reſpect which his abilities commanded; and, although to his intimate friends, they added an inexpreſſible charm to his converſation, while they diſplayed, in the moſt intereſting light, the artleſs ſimplicity of his heart; yet it would require a very ſkilful pencil to preſent them to the public eye. He was certainly not fitted for the general commerce of the world, or for the buſineſs of active life. The comprehenſive ſpeculations with which he had been occupied from his youth, and the variety of materials which his own invention continually ſupplied to his thoughts, rendered him habitually inattentive to familiar objects, and to common occurrences; and he frequently exhibited inſtances of abſence, which have ſcarcely been ſurpaſſed by the fancy of BRUYERE. Even in company, he was apt to be ingroſſed with his ſtudies; and appeared, at times, by the motion of his lips, as well as by his looks and geſtures, to be in the fervour of compoſition. I have often, however, been ſtruck, at the diſtance of years, with his accurate memory of the moſt trifling particulars; and am inclined to believe, from this and ſome other circumſtances, that he poſſeſſed a power, not perhaps uncommon among abſent men, of recollecting, in conſequence of ſubſequent efforts of reflection, many occurrences which, at the time when they happened, did not ſeem to have ſenſibly attracted his notice.

To the defect now mentioned, it was probably owing, in part, that he did not fall in eaſily with the common dialogue of converſation, and that he was ſomewhat apt to convey his own ideas in the form of a lecture. When he did ſo, however, it never proceeded from a wiſh to ingroſs the diſcourſe, or to gratify his vanity. His own inclination diſpoſed him ſo ſtrongly to enjoy in ſilence the gaiety of thoſe around him, that his friends were often led to concert little ſchemes, in order to bring him on the ſubjects moſt likely to intereſt him. Nor do I think I ſhall be accuſed of going too far, when I ſay, that he

was

was ſcarcely ever known to ſtart a new topic himſelf, or to appear unprepared upon thoſe topics that were introduced by others. Indeed, his converſation was never more amuſing than when he gave a looſe to his genius, upon the very few branches of knowledge of which he only poſſeſſed the outlines. Account of Dr Smith.

The opinions he formed of men, upon a ſlight acquaintance, were frequently erroneous; but the tendency of his nature inclined him much more to blind partiality, than to ill-founded prejudice. The enlarged views of human affairs, on which his mind habitually dwelt, left him neither time nor inclination to ſtudy, in detail, the unintereſting peculiarities of ordinary characters; and accordingly, though intimately acquainted with the capacities of the intellect, and the workings of the heart, and accuſtomed, in his theories, to mark, with the moſt delicate hand, the niceſt ſhades, both of genius and of the paſſions; yet, in judging of individuals, it ſometimes happened, that his eſtimates were, in a ſurpriſing degree, wide of the truth.

The opinions, too, which, in the thoughtleſſneſs and confidence of his ſocial hours, he was accuſtomed to hazard on books, and on queſtions of ſpeculation, were not uniformly ſuch as might have been expected from the ſuperiority of his underſtanding, and the ſingular conſiſtency of his philoſophical principles. They were liable to be influenced by accidental circumſtances and by the humour of the moment; and when retailed by thoſe who only ſaw him occaſionally, ſuggeſted falſe and contradictory ideas of his real ſentiments. On theſe, however, as on moſt other occaſions, there was always much truth, as well as ingenuity, in his remarks; and if the different opinions which, at different times, he pronounced upon the ſame ſubject, had been all combined together, ſo as to modify and limit each other, they would probably have afforded materials for a deciſion, equally comprehenſive and juſt. But, in the ſociety of his friends, he had no diſpoſition to form thoſe qualified concluſions

Account of Dr Smith.

cluſions that we admire in his writings; and he generally contented himſelf with a bold and maſterly ſketch of the object, from the firſt point of view in which his temper, or his fancy, preſented it. Something of the ſame kind might be remarked, when he attempted, in the flow of his ſpirits, to delineate thoſe characters which, from long intimacy, he might have been ſuppoſed to underſtand thoroughly. The picture was always lively, and expreſſive; and commonly bore a ſtrong and amuſing reſemblance to the original, when viewed under one particular aſpect; but ſeldom, perhaps, conveyed a juſt and complete conception of it in all its dimenſions and proportions.—In a word, it was the fault of his unpremeditated judgments, to be too ſyſtematical, and too much in extremes.

But, in whatever way theſe trifling peculiarities in his manners may be explained, there can be no doubt, that they were intimately connected with the genuine artleſſneſs of his mind. In this amiable quality, he often recalled to his friends, the accounts that are given of good La Fontaine; a quality which in him derived a peculiar grace from the ſingularity of its combination with thoſe powers of reaſon and of eloquence which, in his political and moral writings, have long engaged the admiration of Europe.

In his external form and appearance, there was nothing uncommon. When perfectly at eaſe, and when warmed with converſation, his geſtures were animated, and not ungraceful; and, in the ſociety of thoſe he loved, his features were often brightened with a ſmile of inexpreſſible benignity. In the company of ſtrangers, his tendency to abſence, and perhaps ſtill more his conſciouſneſs of this tendency, rendered his manner ſomewhat embarraſſed;—an effect which was probably not a little heightened by thoſe ſpeculative ideas of propriety, which his recluſe habits tended at once to perfect in his conception, and to diminiſh his power of realizing. He never ſat for his

picture; but the medallion of TASSIE conveys an exact idea of his profile, and of the general expreſſion of his countenance. Account of Dr Smith.

THE valuable library that he had collected he bequeathed, together with the reſt of his property, to his couſin Mr DAVID DOUGLAS, Advocate. In the education of this young gentleman, he had employed much of his leiſure; and it was only two years before his death, (at a time when he could ill ſpare the pleaſure of his ſociety), that he had ſent him to ſtudy law at Glaſgow, under the care of Mr MILLAR;—the ſtrongeſt proof he could give of his diſintereſted zeal for the improvement of his friend, as well as of the eſteem in which he held the abilities of that eminent Profeſſor.

THE executors of his will, were Dr BLACK and Dr HUTTON; with whom he had long lived in habits of the moſt intimate and cordial friendſhip; and who, to the many other teſtimonies which they had given him of their affection, added the mournful office of witneſſing his laſt moments.

DONATIONS presented to the ROYAL SOCIETY *of Edinburgh, continued from the preceding Volume.*

From the Author.

On the Diseases of the Lymphatic Glands, by *James Johnstone*, M. D. Worcester. 1787.

From the Author.

Memoire sur les Isles Ponces, et Catalogue Raisonné des Produits de l'Etna, par M. le Commandeur de Dolomieux. Paris 1788.

From Colonel *Hugh Montgomery* of Skelmorly.

Drawings of a Stone found at Coilsfield in Ayrshire, June 15. 1789.

From Lord *Daer*.

An Esquimaux Dress. March 1. 1790.

From Mr *Somerville Wilson*, Surgeon to the Winterton East Indiaman.

Two Persian MSS. in folio, and an Arabic MS. in quarto. On the latter is this inscription: "MS. of part of the Arabian "Nights Entertainments in Arabic, written by *Moulla Mustapha* at Bassora, and rescued with the original MS. from the "said *Mustapha*'s house after his death of the plague in April "1773."

From Colonel *Macleod* of Macleod.

Three MSS. in the Shanscrit. No. 1. is a copy of the GITA, which is translated by Mr *Wilkins*.

No. 2. is the IRI BAGHAWAT, or the Life of the Indian APOLLO.

No. 3. the CHANDI. See Asiatic Researches, vol. i. p. 280.

Also a MS. of the KORAN in folio. The above are all very beautifully illuminated. The three first are in rolls.

Lift of Donations.

From the Author.

Traité Analytique des Mouvemens apparens des Corps Celeſtes, tom. ii. par M. du *Sejour*.

From the Author.

Memoire ſur la Combuſtion du Gas Hydrogene, par M. *Seguin*. Paris 1790.

From the Author.

Obſervations on the Diſeaſes of Fruit and Foreſt Trees, by Mr *Forſyth*, Kenſington gardens. Nov. 7. 1791.

From the Royal Society of London.

Philoſophical Tranſactions, vol. lxxx.

From the Author.

A treatiſe on the *Angina Pectoris*, by Dr *Butter* of London.

From the Literary and Philoſophical Society at Mancheſter.

Memoirs of the Society, vol. iii. and vol. iv. part 1.

From the Author.

Annali di Chimica, tom. i. di *L. Brugnatelli, Soſtituto alla Catedra di Chemica nel univerſita de Pavia.* 1790.

From the Author.

Experimental Inquiry concerning the Cheltenham Water, and Cautions concerning the Poiſon of Lead and Copper, by *A. Fothergill*, M. D. F. R. S. Lond. *&c.*

From the Author.

Obſervations on Scrophulous Affections, by *Robert Hamilton*, M. D. Lond. 1791.

From

From *James Byers*, Esq; Lift of Donations.

A Series of ancient Roman Weights of Bafaltes or Porphyry. Dec. 19. 1791.

From the Author.

On Electricity, with occafional Obfervations on Magnetifm, by *E. Pert*, M. D. 1791.

On the Properties of Matter and the Principles of Chemiftry, by the fame. 1792.

On Electric Atmofpheres, by the fame. 1793.

From the Royal Society of Antiquaries in Scotland.

The Tranfactions of the Society, vol. i. 1792.

From Profeffor *Heyne* of Gottingen.

Befchreibung der Ebene von Troja, &c. being a tranflation of M. *Chevalier's* paper, [No. I. Lit. Cl. of this Vol.] made under the eye of Profeffor *Heyne*. Leipfic 1792.

From the Royal Irifh Academy.

A Standard Thermometer, conftucted by *Samuel Healy*, Dublin.

POST-

POSTSCRIPT TO THE HISTORY.

ON Monday, the 4th of November 1793, Dr HOPE, Professor of Medicine in the Univerſity of Glaſgow, read a paper, entitled, *An Account of a Mineral from Strontian, and of a peculiar Species of Earth which it contains.* Want of room, and the length of the diſſertation, prevent its appearance in the preſent volume. But as the diſcovery of a new earth cannot fail to be intereſting, it has been thought proper to treſpaſs a little on the order of time, and to inſert here the following abſtract.

THE mineral is found in the lead-mine of Strontian in Argyleſhire. It was brought to Edinburgh about ſix years ago in conſiderable quantity. It was generally received as the aërated barytes. At that time, Dr HOPE had ſome doubts of its being the barytic ſpar, and uſed, in his prelections, when he filled the chemical chair in the Univerſity of Glaſgow, to mention ſuch of its diſtinguiſhing characters as he had then diſcovered. The Strontian ſpar ſometimes is colourleſs, oftener it has a greeniſh or yellowiſh hue. Its texture is fibrous, and it frequently ſhoots into cryſtals, which are ſlender ſpiculæ or hexagonal columns. The ſpecific gravity of it goes from 3.650 to 3.726.

THIS mineral is inſipid, and requires nearly 800 times its weight of water to diſſolve it. It effervеſces with acids, and during ſolution carbonic acid is diſengaged to the amount of 30.2 grains *per cent.* When moderately heated, it crackles, and loſes its tranſparency. By a very vehement heat, the carbonic acid is expelled, and the maſs loſes 38.79 *per cent.* of its weight, and ceaſes to effervеſce with acids. The calcined ſpar, when water is poured on it, ſwells, burſts, and becomes hot in a greater degree, and with more rapidity, than lime. It is acrid,

acrid, and is ſoluble in water. The ſolution of it has a taſte not unlike that of lime-water, changes to a green, paper ſtained with the juice of violets or radiſhes, and on expoſure to the air quickly acquires a cruſt on its ſurface.——The earth of Strontian mineral, which Dr Hope denominates Strontites, requires about 180 times its weight of water, at a low temperature, for its ſolution. In boiling water, it diſſolves much more abundantly, and is depoſited during cooling in the form of cryſtals. Theſe cryſtals are tranſparent and without colour, in the ſhape of quadrangular plates, ſometimes ſquare, more commonly oblong, with the margins cut like a wedge. Now and then are ſeen ſolid parallelopepids and cubes. On expoſure to the action of the air, they become white, powdery and effervefcent, loſing almoſt $\frac{1}{10}$ of their weight. In a dull red heat, they undergo the aqueous fuſion, and a white refractory powder remains. They contain 68 *per cent.* of humidity. Diſtilled water, at temperature 60, diſſolves them ſlowly, in the proportion of 8.5 grains to the ounce. An ounce of water, at a temperature ſufficient to keep the ſolution boiling, diſſolved no leſs than 218 grains. This remarkable ſolubility affords a diſcriminating feature of this earth. An hundred parts of the Strontian mineral conſiſt, of earthy baſis 61.21, of carbonic acid 30.20, and of water 8.59.

Dr Hope next details at great length the phenomena attending the action of ſulphuric, nitric, muriatic, acetous, oxalic, tartaric, fluoric, phoſphoric, arſenic, ſuccinic, boracic and carbonic acids on Strontian mineral in maſs and in fine powder, and deſcribes the properties of the reſulting compounds in regard to ſenſible qualities, effects of air and of heat, and ſolubility in water. It may ſuffice to extract only from what is ſaid on the action of nitric and muriatic acids. Strong nitric acid ſcarcely attacks the ſpar, unleſs aſſiſted by heat. If duly diluted, it diſſolves it rapidly and completely. The ſolution is colourleſs and tranſparent, and having a pungent taſte, yields

cryſtals readily, which, when moſt regular, are octohædral, conſiſting of two quadrangular pyramids, united at their baſes. They effloreſce in a dry atmoſphere, in a moiſt they deliqueſce. One ounce of diſtilled water, at temperature 60, diſſolves an equal weight of this nitrate of Strontites; when boiling, one ounce, ſeven drachms fourteen grains. It deflagrates on hot coals. Subjected to heat in a crucible, it decrepitates gently, melts and boiling loſes its acid. The contact of a combuſtible body at this time cauſes a deflagration, with a beautiful vivid red flame.

Muriatic acid aſſaults the Strontian mineral in a manner very ſimilar to the nitric. The ſolution is free from colour, has a penetrating peculiar taſte, and affords cryſtals freely. Theſe are long ſlender ſpiculæ or hexagonal priſms. Muriate of Strontites, in a very moiſt air, ſhows a diſpoſition to attract humidity, contains 42 *per cent.* of water, and when heated, firſt undergoes the aqueous, then a true fuſion, but without loſs of acid, which may be expelled by a more vehement heat. One ounce of diſtilled water, at temperature 60, diſſolved twelve drachms, one ſcruple; when boiling above four ounces.

Strontites, and all its combinations, poſſeſs the remarkable property of tinging flame of a red colour. The muriate has it in the moſt eminent degree, and its effects are well exhibited by putting a portion of the ſalt on the wick of a candle, which is thereby made to burn with a very beautiful blood-red flame. The nitrate ſtands next, then cryſtallized Strontites, and after it the acetite. The following combinations of little ſolubility give comparatively a very feeble tinge: Tartrite, ſulphate, oxalate, fluate, arſenicate, carbonate, phoſphate, and borate. The order of enumeration denotes their relative tinging powers.

A certain portion of humidity, either belonging to the compoſition or added, is neceſſary to enable any of theſe Strontitic ſalts to alter the hue of the flame. The muriate itſelf, deprived of moiſture, produces no effect.

All the ſolutions of Strontites in acids are decompoſed by the three alkalies in their effervefcent ſtate, and in part by virtue of a double elective attraction. The artificial carbonate of Strontites thus obtained, parts with its fixed air more readily than the native. Pure potaſs ſeparates Strontites from nitric and muriatic acids, but partially, and in a cryſtalline form. Neither pruſſiate of potaſs nor of lime cauſe a precipitate in any of the ſolutions.

Strontites generates a hepar with ſulphur either in the humid or dry way. Its cryſtals are ſparingly diſſolved by alcohol; a yellow coloured tincture reſults.

After finiſhing the detail of the properties of the Strontian mineral and its earthy baſis, Dr Hope proceeds to enquire, whether this foſſil and its earth are ſimilar to any that are already known. He concludes they are not. Strontian ſpar reſembles moſt the aerated terra ponderoſa, and in ſeveral reſpects has a ſtrong analogy with it; yet it eſſentially differs.

Its ſpecific gravity is leſs, it parts with its carbonic acid when urged by heat, ſomewhat more readily, and without ſuffering fuſion; when calcined, it imbibes moiſture with vaſtly greater avidity, ſwelling and cracking with more heat and noiſe. Strontites diſſolves much more abundantly in hot water than barytes, and the form of the cryſtals of theſe pure earths is very diſſimilar. The compounds generated by Strontites differ from thoſe of barytes. It will ſuffice to mention the nitrate and muriate. This earth, united to nitric and muriatic acid, forms ſalts that ſuffer changes from expoſure to air, which do not happen to the nitrate and muriate of barytes. They are likewiſe much more ſoluble in water, and have cryſtals of a peculiar figure.

The combinations of Strontites with acids are not, like thoſe of barytes, decompoſed by pruſſiate of lime or of potaſs.

Strontites

Strontites and its compounds tinge flame, which barytes does not. Laſtly, theſe earths diſagree in the order of their attractions.

From theſe conſiderations, it is concluded, that the mineral is not aërated barytes.

Sometimes the Strontian foſſil reſembles calcareous ſpar; yet they eſſentially differ in property and compoſition. That from Strontian is much heavier, and retains its fixed air with more obſtinacy in the fire. The incomparably greater ſolubility of the pure earth in hot than in cold water, and the cryſtalline form it aſſumes, ſufficiently diſtinguiſh it from lime, which the diſpoſition of the nitrate and muriate to cryſtallize, no leſs tends to do.

The quality of colouring flame does not ſerve here as a circumſtance of diſcrimination, as Dr Hope has diſcovered, that muriate of lime alſo tinges the flame of a red colour, but in a leſs vivid manner. Strontites further differs from lime in the order of its attractions.

No parallel is drawn between Strontian mineral and other earthy bodies, as they have not the ſmalleſt reſemblance.

As the earthy baſis of the Strontian ſpar poſſeſſes remarkable qualities, that are peculiar to it, and forms with acids combinations unlike thoſe generated by the known earths, and differs from all of them in the order of its attractions, the author of the paper concludes, that it is an earth *ſui generis*, a ſeparate and diſtinct genus, conſtituting the ſixth ſimple earth, to which, as above mentioned, he gives the appellation of *Strontites*.

Dr Hope afterwards details a long train of experiments to eſtabliſh the order of the attractions of this new earth; firſt, determining the order in which the principal acids attract it, and then ſhowing the place due to its attraction among thoſe of other ſubſtances for acids. The tables that are ſubjoined exhibit theſe attractions.

Dr

Dr HOPE likewiſe read ſome obſervations on the native carbonate of barytes or aërated terra ponderoſa of Dr WITHERING. The two following deſerve moſt to be noticed.

AFTER quoting the words of Doctors WITHERING and PRIESTLEY, M. SAGE, FOURCROY, PELLETIER, and of Mr WEDGEWOOD *junior*, to ſhow, that they all agree in aſſerting, that the fixed air cannot be expelled by heat from this ſubſtance, he mentioned ſeveral experiments, in which heat alone deprived it of its carbonic acid, rendered the earth cauſtic, and cauſed a loſs of weight equal to 23 *per cent.* He deſcribed the qualities of the calcined barytic ſpar.

THE ſecond obſervation of importance relates to the cryſtallization of the pure barytes, which ſubſtance he has obtained in beautiful and regular cryſtals; the more obvious, as well as chemical properties of which he at full length recounted.

TABLES ſhewing the attraction of and for STRONTITES.

TAB. I.

STRONTITES.
Sulphuric Acid.
Oxalic
Tartarous
Fluoric
Nitric
Muriatic
Succinic
Phoſphoric
Acetous
Arſenic
Boracic
Carbonic

TAB. II.

Sulphuric Acid.	*Oxalic.*	*Tartarous.*	*Fluoric.*	*Nitric.*
Barytes	Barytes	Lime	Lime	Barytes
Strontites	Lime	Barytes	Barytes	Potaſs
Potaſs	Strontites	Strontites	Strontites	Soda
Soda	Potaſs	Potaſs	Potaſs	Strontites
Lime	Soda	Soda	Soda	Lime

Muriatic.	*Arſenic.*	*Phoſphoric.*	*Boracic.*	*Carbonic.*
Barytes	Lime	Lime	Lime	Lime
Potaſs	Barytes	Barytes	Barytes	Barytes
Soda	Strontites	Strontites	Strontites	Strontites
Strontites	Potaſs	Potaſs	Potaſs	Potaſs
Lime	Soda	Soda	Soda	Soda

The Brackets in Tab. II. denote, that it has not been diſcovered how Strontites ſtands with regard to Barytes and Lime, in its attraction for the acid below which this mark is made.

END OF THE HISTORY.

I.

PAPERS OF THE PHYSICAL CLASS.

I. EXPERIMENTS *and* OBSERVATIONS *on the* UNEQUAL REFRANGIBILITY *of* LIGHT. *By* ROBERT BLAIR, M. D.

[*Read Jan.* 3. *and April* 4. 1791.]

BY the diſcovery of the different refrangibility of light, Sir ISAAC NEWTON laid open the true cauſe of the principal imperfection of refracting teleſcopes; and having inferred from the experiments which he made, that the refraction of the different rays compoſing the priſmatic ſpectrum, was always in a given ratio to the refraction of the mean refrangible ray, this great philoſopher was led to conclude, that the imperfection which he had diſcovered in dioptrical inſtruments was without remedy.

IF Sir ISAAC NEWTON had been queſtioned concerning the poſſibility of refracting light, without any divergency of the heterogeneal rays, his reply without doubt would have been, that all his experiments, whether by ſingle refractions or by oppoſite refractions, tended to eſtabliſh the contrary concluſion. But that he would have aſſerted nothing beyond this, may ſafely be inferred from his own memorable words: " Although " the arguing from experiments and obſervations by induction " be no demonſtration of general concluſions, yet it is the beſt

" way of arguing which the nature of things admits of, and " may be looked upon as ſo much the ſtronger by how much " the induction is more general; and if no exception occur " from phenomena, the concluſion may be pronounced gene- " rally; but if at any time afterwards any exception ſhall " occur from experiments, it may then begin to be pronounced " with ſuch exceptions as occur."

THIS is the general doctrine which he lays down as applicable in all experimental enquiries; and ſo far was he from conſidering the particular caſe above mentioned as an exception to this general rule, that from ſome expreſſions he makes uſe of, it evidently appears, that he was not without ſuſpicion, of what has ſince been diſcovered to be the truth.

IN his ſixth letter to Mr OLDENBURGH, dated from Cambridge in the year 1662, he expreſſeth himſelf in the following words: " Mr HOOK thinks himſelf concerned to reprehend " me for laying aſide the thoughts of improving optics by re- " fraction. What I ſaid there was in reſpect of teleſcopes of " the ordinary conſtruction, ſignifying that their improvement " is not to be expected from the well figuring of glaſſes, as op- " ticians have imagined. But I deſpaired not of their im- " provement by other conſtructions, which made me cautious " to inſert nothing that might intimate the contrary. For al- " though ſucceſſive refractions which are all made the ſame " way, do neceſſarily more and more augment the errors of " the firſt refraction, yet it ſeemed not impoſſible for contrary " refractions ſo to correct each others unequalities, as to make " their difference regular; and if that could be conveniently " effected, there would be no farther difficulty. Now to this " end I examined what may be done, not only by glaſſes alone, " but more eſpecially by a complication of diverſe ſucceſſive " mediums; as by two or more glaſſes or cryſtals, with water, " or ſome other fluid, between them; all which together may " perform the office of one glaſs, eſpecially of the object glaſs,

" on

"on whofe conftruction the perfection of the inftrument
"chiefly depends. But what the refults in theory or by trials
"have been, I may poffibly find a more proper occafion to de-
"clare."

In the year 1757, the late Mr John Dollond, in confequence of fome ftrictures on Sir Isaac Newton from abroad, repeated the noted experiment of refracting a ray of light through prifms of glafs and water, placed with their refracting angles in oppofite directions, and fo proportioned to each other, that the ray, after thefe oppofite refractions, emerged parallel to the incident ray. According to the Newtonian doctrine, there ought here to have been no divergency of the heterogeneal rays, and no colour produced by thefe equal and oppofite refractions.

But this was not the refult of the experiment. The ray was coloured very fenfibly; and the author of the experiment finding that he could, by thefe oppofite refractions, produce colour, notwithftanding the parallelifm of the incident and emergent light, with reafon concluded that he might, by properly proportioning the refracting angles of his prifms, effect an inclination of the refracted to the incident light, without any colour or divergency. The event turned out as he expected.

Pushing his experiments farther, he difcovered, fome time afterwards, that a colourlefs refraction might be produced by a combination of different kinds of glafs, as well as by a combination of glafs and water, which feemed to remove completely the great obftacle to the perfection of the refracting telefcope, difcovered by Sir Isaac Newton.

As it was found foon afterwards, that the other principal imperfection which limits the performance of telefcopes, namely, the aberration arifing from the fpherical figures of lenfes, might be corrected by properly proportioning to each other the fphericities of the convex and concave lenfes, of which the compound object glafs is compofed; it was expected by men of fcience, that an increafe of the aperture and power of the inftrument,

ſtrument, would be the neceſſary conſequence of ſuch important ſteps, towards the perfection of its theory. Theſe expectations have not hitherto been fully anſwered.

If the theory of the achromatic teleſcope is ſo complete as it has been repreſented, may it not reaſonably be demanded, whence it proceeds, that Hugenius and others could execute teleſcopes with ſingle object glaſſes eight inches and upwards in diameter, while a compound object glaſs of half theſe dimenſions, is hardly to be met with? or how it can ariſe from any defect in the execution, that reflectors can be made ſo much ſhorter than achromatic refractors of equal apertures, when it is well known that the latter are much leſs affected by any imperfections in the execution of the lenſes compoſing the object glaſs, than reflectors are by equal defects in the figure of the great ſpeculum?

The general anſwer made by artiſts to enquiries of this kind, is, that the fault lies in the imperfection of glaſs, and particularly in that kind of glaſs of which the concave lens of the compound object glaſs is formed, called flint-glaſs.

It was in order to ſatisfy myſelf concerning the reality of this difficulty, and to attempt to remove it, that I engaged in the following courſe of experiments. The reſult of this inveſtigation I now do myſelf the honour of ſubmitting to the Royal Society.

The imperfections of glaſs for optical purpoſes ariſe partly from its want of perfect tranſparency, and from being more or leſs affected with a tinge of ſome particular colour, but principally from irregularities which are frequently found in its refractive denſity. This laſt imperfection is ſo conſtant an attendant upon flint-glaſs, and every other kind of glaſs which poſſeſſes the diſperſive quality in a conſiderable degree, that it has been ſuſpected, not without appearance of reaſon, to ariſe neceſſarily from that ingredient in its compoſition on which this

this quality depends. It is certain that great labour and expence have been beſtowed on this object without the deſired effect.

Considering therefore that it is not impoſſible to introduce a fluid medium to ſupply the place of one of the lenſes, in the compound achromatic object glaſs, I was deſirous of ſearching whether nature afforded fluids poſſeſſed of the requiſite qualities.

It appears from the paſſage already quoted, that Sir Isaac Newton not only ſuſpected that optical inſtruments might admit of improvement by a combination of ſolid and fluid mediums, but had actually made experiments on the ſubject, and conſidered this as the moſt likely means of carrying theſe inſtruments to their greateſt perfection.

Dr David Gregory, Savilian profeſſor of aſtronomy at Oxford, entertained ſimilar ideas on this ſubject, as appears from his treatiſe, entitled, "Catoptricæ et Dioptricæ Sphæricæ "Elementa." In this work, which was publiſhed at Edinburgh in the year 1713, he treats of optical inſtruments, both by refraction and reflection; and, after ſhewing the advantages of the latter in theory, concludes his treatiſe with the following words: "Quod ſi ob difficultates phyſicas, in ſpeculis idoneis "torno elaborandis et poliendis, etiamnum lentibus uti oporteat, fortaſſis media diverſæ denſitatis ad lentem objectivam "componendam adhibere utile foret, ut a natura factum obſervemus in oculi fabrica, ubi chriſtallinus humor (fere ejuſdem cum vitro virtutis ad radios lucis refringendos) aqueo et "vitreo (aquæ, quoad refractionem, haud abſimilibus) conjungitur, ad imaginem quam diſtinctè fieri potuit, a natura nihil fruſtra molienti, in oculi fundo depingendam: ſed et "alii ſunt in animalis oculo, prædicti artificii uſus, qui non "ſunt hujus loci."

This coincidence of opinion of theſe great opticians reſpecting the ultimate perfection attainable by the teleſcope, deſerves

to be remarked. Various attempts of this kind have been made by later philoſophers and artiſts. Indeed, the ſtructure of the eye, compoſed of ſolids and fluids variouſly combined, ſeems to preſent ſo obvious and inſtructive a pattern for imitation, that it is no wonder if the expectations entertained of the productions of art, roſe in proportion as they could be made to approach the conſtruction of this exquiſite model of Divine workmanſhip.

Mr DOLLOND's firſt experiments went no farther than to prove to him, that glaſs diſperſes the heterogeneal rays of light more than water, when the refraction of the mean refrangible ray is equal in both mediums. With theſe ſcanty data, this able artiſt zealouſly went to work to conſtruct teleſcopes on this new diſcovered principle. But on this occaſion his attempts were not attended with any degree of ſucceſs. This need not much be wondered at. Beſides the difficulty he mentions, ariſing from the ſpherical aberration, (which, by the by, if he had conſidered the matter more attentively, he would have ſeen to be eaſily ſurmountable) he would find between plate-glaſs and water, but an inconſiderable difference of diſperſive power; and if he made uſe of flint-glaſs he would have all thoſe difficulties to ſtruggle with, which his ſucceſſors have not been able to remove, though fully apprized of their cauſe.

THIS want of ſucceſs in his firſt trials with fluids, and the diſcovery he ſoon after made of a difference in the diſperſive power of different kinds of glaſs, which he was more ſucceſsful in applying to the improvement of teleſcopes, ſeems to have put an end to all thoughts of the uſe of fluids, nor has any thing of that kind been ſince attempted, as far as I have been able to learn, ſome unſucceſsful trials excepted, to conſtruct thoſe ſmall perſpectives called opera glaſſes, on a plan ſimilar to that of Mr DOLLOND, by including ſpirit of wine between two concave meniſcuſes of flint-glaſs, the fluid ſupplying the

place

place of crown-glaſs, and the advantage propoſed being a ſaving of the light loſt by reflection.

The experiments of Mr Dollond proved, that the diſperſive power of water is leſs than that of the glaſs with which he made his experiments; and it ſeems wonderful that this ſhould have been almoſt the only attempt made to inveſtigate this quality in fluid mediums. We find many tables aſcertaining the mean refractive denſity of fluids, from experiments made both before the diſcovery of Dollond and ſince. But though ſome of the fluids examined were poſſeſſed of the diſperſive quality in a remarkable degree, this is paſſed over unobſerved, and it would ſeem unſuſpected, if we except the very ingenious conjecture of Mr Michel; to whom it occurred, that the apparent difference in the experiment above mentioned, made by Sir Isaac Newton, from the ſame experiment repeated by Mr Dollond, might ariſe from the former uſing, inſtead of pure water, a ſolution of Saccharum Saturni, which he mentions his having ſometimes made uſe of to increaſe the refraction. Mr Michel ſuſpected that lead, even in this form, might increaſe the diſſipative refraction, as it does in the compoſition of glaſs. The reſult of his experiments on this ſubject may be ſeen in the additions to Dr Priestley's Optics, at the end of the ſecond volume.

Of the methods employed for inveſtigating the optical qualities of different mediums.

In aſcertaining the mean refractive and diſperſive qualities of fluids, I made uſe of two kinds of apparatus. Where the properties of the fluids were entirely unknown, priſms were employed to come to a groſs knowledge of their properties, and thoſe fluids which promiſed to be of uſe in the practical part of optics, were more critically examined by means of lenſes, where

the effect, from being magnified, becomes more conspicuous.

The prismatic apparatus consists of a small prism of brass, whose three angles are equal. Through this prism, and parallel with one of its sides, are bored two holes at a small distance from each other, equal in size to the pupil of the eye. The sides of the prism are ground flat, and there are two bits of glass with parallel sides, of the same dimensions as the sides of the prism. There are also prisms of the same size, and with the same angles of different kinds of glass, and some crown-glass prisms, with smaller angles, which, by being applied to the large prism, or to each other, vary the refracting angle at pleasure.

When it is proposed to try the properties of any fluid, one of the small plates of glass is applied over the holes on the side of the brass prism. A few drops of the fluid are then dropped into the hole; and when it is full, the other plate is laid over the holes upon the opposite side, and the whole is secured by tying a bit of pack-thread round the ends. One of the glass prisms is now to be applied to the brass prism, contiguous with one of the parallel plates, the refracting angles of the two prisms being placed in opposite directions, so as to form a small parallelepiped.

Nothing farther is necessary than to apply the eye to the hole which contains the fluid, in such a way as to observe through it any bright well defined object. The bars of the window answer the purpose very well in the day-time, and the moon, or a candle in the night. The intention of the two holes is for the sake of greater expedition. The properties of two fluids may thus be examined and compared at the same time.

As the prismatic portion of fluid and the glass prism have equal refracting angles, and refract in opposition to each other, it will easily be understood, that if the object seen through the

two

two prifms coincides with the fame object feen directly, the mean refractive denfity of both mediums will be the fame. When this is the cafe, if the object feen through thefe prifms appears free from prifmatic colour, the difperfive power of the fluid medium is alfo the fame with the difperfive power of the glafs prifm. But otherwife they will be different.

Those mediums, it is to be obferved, are faid to have the fame mean refractive denfity, which, under equal obliquities of incidence, equally refract the mean refrangible rays, and two mediums are faid to have the fame difperfive power, which produce an equal inclination of rays of the fame colour, to the mean refrangible ray, when the whole refraction of the mean refrangible ray is equal in both.

When an object, feen through the equal wedges of glafs and fluid, appears coloured, one of the fmaller glafs wedges is to be applied and fhifted till the object appears colourlefs. It is eafy to diftinguifh, by the order in which the prifmatic colour lies, whether the fmall prifm is to be applied in fuch a way as to increafe the difperfion of the rays occafioned by the fluid, fo as to enable it to counterbalance that of the glafs; or whether the refracting angle of the glafs prifm requires to be enlarged, to enable it to counteract the difperfion occafioned by the fluid.

By proceeding in this way to fhift the angles of the prifms, till, firft, the direct and refracted images of an object coincide, without regarding the colour; and, next, till the refracted image appears colourlefs, without regarding the coincidence; the ratio of the mean refractive and difperfive powers of that kind of fluid, and that kind of glafs, with which the experiments are made, will be obtained, from the angles of the prifms being given in both cafes.

In order to afcertain the abfolute refractive denfity of glafs, or any other medium, that is to fay, the general ratio of the fines of the angles of incidence to the fines of the angles of re-

fraction of the mean refrangible ray, which obtains in that medium, I took a direct method, similar in principle to that employed by Sir Isaac Newton, and described by him in the seventh proposition of the first book of his Optics, and likewise in his Optical Lectures, p. 54. ; but which I may venture to say will be found much easier, and perfectly accurate.

Instead of causing the rays to pass through the sights of a large and accurate quadrant, at the distance of ten or twelve feet, as directed by Sir Isaac Newton, I employed a Hadley's quadrant, in the following manner:

Fig. 1.—I represents the index-glass and H the horizon-glass of a Hadley's quadrant. S I represents a solar ray, incident on the index-glass, thence reflected to the horizon-glass H, and from it to the eye at E. The line s g represents another solar ray, incident on the prism P, and through it refracted to the eye at E. When the prism is turned slowly round its axis, till the spectrum G appears at its greatest height, this is its proper position. The angle formed by the direct and refracted ray is then the least possible, and the angles of incidence and emergence are equal. Let the prism be secured in this position. A slight inspection of the figure will shew, that when the reflected and refracted images of the sun are made to coincide, the angle marked by the index of the quadrant, is the same which the incident ray s g forms with the refracted ray P E produced. For S Z H is the angular distance of the sun and his doubly reflected image, marked by the index; and the angle s g G, which the ray incident on the prism forms with the refracted ray produced, is equal to it; s g and S I being parallel, and P Z and H Z being coincident.

The manner in which the ratio of the sines of the angles of incidence and refraction may be computed from the above angle, and the refracting angle of the prism being given, is fully explained in the celebrated works which have just been quoted.

It

It may be proper here to remark, that as it is the ratio of refraction of the mean refrangible ray which is wanted, the centre of the reflected image of the fun ought to be made to coincide with the centre of the coloured fpectrum, as reprefented in the figure; and if, inftead of this, the coincidence is formed with the moft or leaft refrangible ray, or any of the intermediate rays, it will be the ratio of refraction of thefe rays, and not of the mean refrangible ray, which will be found from the obfervation. Hence this method might be practifed for determining the difperfive power, as well as the mean refractive denfity of any tranfparent fubftance, whether folid or fluid; but I have preferred a combination of prifms or lenfes, becaufe it is the relative ratios, more than the abfolute ratios, which are moft immediately wanted.

Experiments on the difperfive powers of fluids.

I EXAMINED, by the prifmatic apparatus which has been defcribed, the optical properties of a great variety of fluid mediums. It will fuffice to mention the moft remarkable of thefe. Many folutions of metals and femi-metals, in different forms, were fubjected to trial, and thefe were always found to be more difperfive than crown-glafs. The folution of fome falts in water, as for inftance of crude fal ammoniacum, greatly increafes its difperfive power. The marine acid difperfes very confiderably, and this quality increafes with its ftrength. Hence I found the moft difperfive fluids to be thofe in which the marine acid and the metals are combined. The chemical preparation called *cauflicum antimoniale* or *butyrum antimonii*, in its moft concentrated ftate, when it has juft attracted fufficient humidity to render it fluid, poffeffes the quality of difperfing the rays in fuch an aftonifhing degree, that three wedges of crown-glafs are neceffary to remove the colour produced by one wedge of this

fubftance,

ſubſtance, of an equal refracting angle, oppoſed to them. The great quantity of the ſemi-metal retained in ſolution, and the highly concentrated ſtate of the marine acid, ſeem to be the cauſe of this ſcarce credible effect.

CORROSIVE ſublimate mercury, added to a ſolution of crude ſal ammoniacum in water, poſſeſſes the next place to the butter of antimony among the diſperſive fluids which I examined. It may be made of ſuch a degree of ſtrength, as to require a wedge of crown-glaſs, of double the refracting angle, to remove the colour which a priſm of it produces. The mercury and marine acid contained in this ſolution, are manifeſtly the cauſe of its diſperſive power. For neither the water nor the volatile alkali, which are its other component parts, will be found capable, if tried ſeparately, of contributing towards this effect.

THE eſſential oils were found to hold the next rank to metallic ſolutions, among fluids which poſſeſs the diſperſive quality. The moſt diſperſive I found to be thoſe obtained from bituminous minerals, ſuch as the native petrolea, pit-coal and amber. When the refraction is without colour, the proportion of the refracting angle of a priſm of theſe, to the refracting angle of a priſm of crown-glaſs acting in oppoſition, is about two to three. The diſperſive power of the eſſential oil of ſaſſafras, is not much inferior to theſe. The eſſential oil of lemons, when genuine, requires the refracting angles of the priſms neceſſary to produce a colourleſs refraction, to be as three to four. In oil of turpentine, this proportion is as ſeven to ſix; and the eſſential oil of roſemary is ſtill leſs diſperſive.

SOME expreſſed oils which were examined, were found not to differ ſenſibly in diſperſive power from crown-glaſs, which was alſo the caſe with rectified ſpirits, and with nitrous and vitriolic æther.

A

A VARIETY of other fluids were examined in the ſame way; but not having yet collected them into a table, I have only mentioned, in general terms, the moſt remarkable.

HAVING been thus ſucceſsful beyond my hopes, in diſcovering fluids capable of removing the great imperfection of teleſcopes, ariſing from the different refrangibility of light, the next object was, to ſelect from this variety thoſe which ſeemed beſt adapted to optical purpoſes.

THERE can be no doubt that thoſe mediums which moſt diſperſe the rays, are, *cæteris paribus*, to be preferred. It will alſo be found, when the method of correcting thoſe errors, which ariſe from the ſpherical figures of lenſes, comes to be conſidered, that there is apparently an advantage in uſing a diſperſive medium, whoſe mean refractive denſity exceeds the mean refractive denſity of crown-glaſs.

As the antimonial cauſtic poſſeſſes both theſe advantages, in a degree far beyond what was to be expected in any fluid, I included ſome of it between two double convex lenſes of crown-glaſs, whoſe radii of convexity were as two to one. The leaſt convex ſides of theſe were turned towards each other, and they were kept at a proper diſtance by means of a glaſs-ring. The cavity was then filled with the ſtrongeſt butter of antimony. Here it is evident that there is a concave lens of the diſperſive fluid, acting in oppoſition to the two convex lenſes of crown-glaſs, and that the proportion of the radii of theſe is the ſame which was found by the priſms to correct the colour, namely, three wedges of crown-glaſs, to one of the butter of antimony.

THIS compound object-glaſs being put into a tube, an eye-glaſs was applied, and, according to expectation, the colour was found to be removed. But I was ſurpriſed to find, on directing the inſtrument to a planet, and uſing a deep eye-glaſs, that this fluid, in its highly concentrated ſtate, was ſubject, like

flint-

flint-glafs, to great irregularities in its denfity, difcoverable by ftreams of light, like comet's tails, iffuing in different directions from the difc of Venus, which was the planet obferved. By fhaking the object-glafs, thefe might be, in a great meafure, removed, but foon returned; and after ftanding all night, broad veins, in different parts of the included fluid, were perceptible to the naked eye.

It was neceffary on this account to reject very denfe fluids. The antimonial preparation I found might be reduced to a fufficient degree of fluidity, by mixing it with fpirit of wine or vitriolic æther, into which a fmall quantity of the marine acid had been previoufly dropped. This prevents any precipitation of the femi-metal in the form of a calx. In this diluted form, either this preparation, or the folution of corrofive fublimate mercury alone, in fpirit of wine, or in water, with the addition of crude fal ammoniacum, may be employed for producing refraction without colour, and without being fubject to that irregularity of denfity to which flint-glafs, and very denfe difperfive fluids, are fubject.

But as folutions of faline fubftances in this diluted ftate do not differ materially in difperfive power from the effential oils, thefe two kinds of fluids may be ufed indifferently.

There is, however, a particular cafe, in which water or vitriolic æther, impregnated with antimony or mercury, will have the advantage, from being lefs denfe than effential oils; and that is, where it is required to produce a fingle refraction, in which there fhall be no difference of refrangibility of heterogeneal light. As this expreffion may found ftrange in the ears of opticians, I fhall, before proceeding farther in the application of the experiments which have been recited, explain what is meant by it.

Cafes

Cases of refraction in which the violet rays are least refrangible, and the red rays most refrangible; or in which all the rays are equally refrangible; or in which the red rays are refracted from the perpendicular, and the violet rays towards the perpendicular, while the mean refrangible rays suffer no refraction.

It has been mentioned, that when prisms of crown-glass and oil of turpentine refract in opposition, the transmitted light is colourless, when the proportion of the refracting angles of these prisms is as seven to six. Hence, if oil of turpentine be included between two double convex lenses, the radii of whose convexities are as six to one, and the deep sides of these be placed inwards, so as to be in contact with the fluid; in the refraction through this compound lens, the aberration from the difference of refrangibility will be removed. I can prove the truth of what I write, by a compound object glass of this kind, which I have had in my possession above four years. It is twenty inches in focal length, and its performance as a telescope, with one inch and a half of aperture, is not contemptible. Now, it has long ago been ascertained, that the mean refractive density of oil of turpentine is less than that of glass; and thence I affirm, that when light passes from crown-glass into oil of turpentine, a considerable refraction of the whole pencil from the perpendicular takes place, and the violet rays are, in this case, the least refrangible, and the red rays the most refrangible.

This is manifest from the facts which have just been stated. In the object-glass above mentioned, there are four refractions, all of which are made in the same direction; namely, two refractions at the two external surfaces of the lenses, which are in contact with air, and two at the internal surfaces, which are in contact with oil of turpentine.

In the refractions which take place in the confine of glaſs and air, it has been put beyond all doubt, by Sir Isaac Newton's experiments, that the red rays are leaſt refracted, and the violet rays moſt refracted; and it is equally clear, from what has juſt been mentioned to be the reſult of trials with priſms, and from the correction of colour in the above mentioned object-glaſs, that when light paſſes obliquely out of crown-glaſs into oil of turpentine, it is refracted from the perpendicular, and the red rays are moſt refracted, and the violet rays leaſt refracted. If this were otherwiſe, the heterogeneal rays, which are made to diverge in two refractions, which take place in the confine of glaſs and air, could never have this divergency removed by the refractions made in the confine of glaſs and the fluid. It is manifeſt, that if, in theſe laſt mentioned refractions, the ſeparation of the heterogeneal rays were in the ſame order as in the refraction from air into glaſs, the colour and divergency of the rays, inſtead of being removed by them, would be increaſed.

I shall not enter upon the application of this fact to the beſt received theories of refraction; but it may be worth while to remark the great importance of minute accuracy in obſerving the reſults of experiments. Dr Hook attempted to make object-glaſſes of teleſcopes, by interpoſing a fluid between a plano-convex lens, and a piece of glaſs, both ſides of which were plane and parallel. The convex ſide of the lens was turned inwards; and the author ſeems to have had no other view in this ſcheme, but to obviate the difficulty which was found in giving a good figure to lenſes ground to very long radii. The refraction being thus reduced to that which takes place in the confine of glaſs and the fluid employed, may be diminiſhed in any proportion, and conſequently the focal length of the object-glaſs lengthened at pleaſure. One of the fluids which he appears to have made uſe of, was oil of turpentine. The difference between the phenomena attending an object-glaſs of this conſtruction

conſtruction and a ſimple lens, if they had been attentively obſerved, would have led Dr HOOK to the truth; and a man of his zeal and invention would not have failed to apply the diſcovery to the improvement of optics, not to mention the triumph it would have afforded the opponent and rival of NEWTON, to have aſſerted, and had it in his power to make good his aſſertion, that in ſome caſes the violet rays are the leaſt refrangible, and the red rays the moſt refrangible.

EVEN Mr DOLLOND could not conceive that the priſmatic colour could be corrected by refractions which are all made the ſame way; and ſtill leſs would he have admitted that ſingle refractions may take place without divergency or colour *. As this continues to be the opinion of the beſt informed opticians of the preſent day, it will be neceſſary to enter into a more explicit inveſtigation of the ſubject.

FIG. 2. Let A B C repreſent a glaſs priſm, and B C D a priſm of water in contact with it; and let the angles of theſe priſms be ſo proportioned to each other, that a ray of light S I, which enters the glaſs priſm perpendicularly, ſhall, after being refracted from the perpendicular at the point G, in paſſing out of the glaſs into the water, emerge at K, perpendicular to the ſide C D of the water priſm, which is ſuppoſed to be confined by parallel plates of glaſs. As the ray both enters and emerges from the refracting mediums perpendicularly, it will ſuffer no refraction, excepting when it paſſes from the glaſs into the water, where its incidence is oblique. Here it will be refracted from the perpendicular, and will emerge coloured, the violet rays being moſt refracted, and the red rays leaſt refracted.

LET the water be now impregnated with antimony or mercury, to increaſe its diſperſive power. As this will alſo increaſe its mean refractive denſity, and occaſion a diminution of the

C 2 refraction

* Philoſophical Tranſactions of London, vol. l. page 740.

refraction in paſſing into it from the glaſs, conceive the angle BCD to be diminiſhed as the refraction diminiſhes, ſo that the refracted ray GK ſhall ſtill emerge perpendicular to DC. When the angles of the glaſs priſm and priſm of diſperſive fluid bear to each other a certain proportion, the ray will be found to emerge colourleſs; and when this happens, it is evident that all the rays are equally refracted at the point G, in paſſing out of the glaſs into the fluid. For they ſuffer no other refraction whatever.

This is a neceſſary conſequence of the glaſs and fluid differing in their mean refractive denſity, and of the rarer medium poſſeſſing the requiſite degree of diſperſive power.

This caſe of a ſingle refraction taking place, without any difference of refrangibility of the rays, may be illuſtrated by Sir Isaac Newton's explication of refraction, by means of attraction, in the following manner. He ſuppoſes refraction to ariſe from an attracting force acting on light, in lines perpendicular to the ſurface of the medium; and the cauſe of one kind of rays being more refracted than another, to ariſe from their being more attracted.

When the medium is ſurrounded by a vacuum, the refraction will be proportioned to the whole attracting force of that medium. But when light paſſes from one refracting medium into another, it will only be attracted by the difference between their attracting forces, as they act in oppoſition to each other.

Now, if the difference of attraction of the moſt and leaſt refrangible rays were, in all mediums, proportioned to the whole attraction of the mean refrangible ray, it would be impoſſible to produce refraction without colour *. But ſubſequent experiments

* This at leaſt is true as to ſenſe in thoſe ſmall refractions which take place in teleſcopes and microſcopes; and it would be mathematically true in all caſes, if the angles of incidence and refraction were proportional. But as it is not the angles themſelves which are ſo, but their ſines, it is a miſtake to ſuppoſe that colourleſs refraction cannot be produced by large contrary refractions of the ſame medium, properly diſpoſed for the purpoſe.

experiments have proved, that this ſuppoſed general law of refraction does not hold in nature.

In the inſtance before us, if we ſuppoſe the force with which glaſs attracts the red, green and violet rays to be repreſented by the numbers five, ſix and ſeven; then may the force with which the diſperſive fluid attracts theſe rays, be repreſented by the numbers four, five and ſix. For the reaſon why all the rays are equally refracted in their tranſition from one of theſe mediums into the other, is becauſe the rare medium has the property of refracting the violet rays more, and the red rays leſs, than the denſe medium, when the obliquity of incidence is ſo proportioned to their denſity, that the mean refrangible ray ſhall ſuffer the ſame refraction in both.

Now, in the caſe above ſtated, the attraction of the rare medium for the ſeveral rays, is ſo proportioned to the attraction of the denſe medium for theſe ſame rays, that the difference of theſe attractions is every where equal, and conſequently the refraction ariſing from theſe differences of attraction is alſo equal. Thus the green ray is attracted by the denſe medium with the force ſix, and by the rare medium with the force five, the difference of which is one; and there is the ſame difference between the attracting forces acting on the red and violet rays in the two mediums, being in one caſe the difference between five and four, and in the other between ſix and ſeven; ſo that the difference of attracting force, and conſequently the refraction ſuppoſed to ariſe from it, is the ſame in all the rays, being always that which will be produced by an attracting force, repreſented by unity.

If the diſperſive power of the rare medium, of which the priſm B C D is formed, be ſtill farther increaſed, the red rays will become the moſt refrangible, and the violet rays the leaſt refrangible; a law of refraction, which, as has been already explained, obtains when light is refracted in the confine of crown-glaſs and oil of turpentine, and of many other fluids.

If

If the mean refractive denſity of the diſperſive fluid, contained in the priſm B C D, be ſo far increaſed as to become equal to the mean refractive denſity of the glaſs priſm A B C, the mean refrangible ray will ſuffer no refraction in paſſing obliquely from the one medium into the other at the point G, but the violet ray will be refracted towards the perpendicular, and the red ray will be refracted from the perpendicular. The reaſon of which is, that the diſperſive medium refracts the violet ray more, and the red ray leſs than the other medium; ſo that the former may be conſidered as an equally denſe medium with the latter relative to the green ray, but more denſe relative to the violet ray, and leſs denſe relative to the red ray.

This caſe of refraction takes place in the confine of crown-glaſs and butter of antimony, when the latter is ſo far diluted as to have the ſame mean refractive denſity with crown-glaſs; that is to ſay, when both mediums equally refract the green ray, under equal obliquities of incidence.

These varieties of refraction will poſſibly be better comprehended by the aſſiſtance of diagrams.

Fig. 3. repreſents a priſm of crown-glaſs, which is entered perpendicularly by a red, green and violet ray, moving parallel with each other. As their incidence on the ſecond ſurface of the priſm is oblique, they will, in paſſing from the glaſs into air, be refracted from the perpendicular. This deflection of the light from its rectilineal courſe, is ſuppoſed to be produced by the perpendicular attracting forces, repreſented by the numbers five, ſix and ſeven. The violet ray will therefore be moſt deflected, the green next, and the red ray leaſt.

Fig. 4. repreſents a priſm of diſperſive fluid, which the three rays enter with the ſame degree of obliquity which they had before they emerged from the glaſs priſm. The attracting forces of the fluid for the ſeveral rays, are repreſented by the numbers

numbers four, five, six; and each of them will be deflected towards the perpendicular, in a degree proportioned to the force acting on it.

Fig. 5. represents the two prisms in contact, and the three rays entering the glass prism perpendicularly, and emerging perpendicularly from the fluid; so that the only refraction they suffer in their passage, is in the confine of the two mediums.

At the point of contact, the rays will be acted on by both mediums, with the same forces which they exerted when separate. But these forces will act in opposition, and therefore the rays will only be affected by their difference; and as the difference of attraction of the two mediums is the same in all the rays, they will all be equally refracted. The red ray is attracted towards the glass by the difference between the forces four and five, the green by the difference between five and six, and the violet by the difference between six and seven, each of which differences is equal to unity, as represented in the figure.

If the dispersive power of the fluid, contained in the prismatic vessel, be diminished by decreasing the proportion of mercury or antimony which it contains, the violet ray will begin to be more refracted, and the red ray less refracted, than the green ray. But if that quality be increased, the contrary of this will happen; the red ray now becoming the most refrangible, and the violet ray the least refrangible.

If the dispersive medium employed, be of that precise degree of strength, which enables it to refract the green ray in the same degree in which it is refracted by crown-glass; in this case it has been asserted, that when light passes obliquely from the one of these mediums into the other, the green rays will suffer no refraction, but the red rays will be refracted from the perpendicular, and the violet rays towards the perpendicular. The reason of this will appear from inspecting the three following diagrams.

Fig.

Fig. 6. reprefents a prifm of crown-glafs, in which the red, green and violet rays, at their emergence into air, are attracted, as before, with the forces five, fix and feven.

Fig. 7. reprefents a prifmatic veffel filled with butter of antimony, whofe mean refracting force is equal to that of the crown-glafs, fo that the green ray is attracted by it with the force fix. But in confequence of its great difperfive power, the red and violet are attracted, (we fhall fuppofe for the fake of round numbers) with the forces four and eight.

Fig. 8. reprefents the two prifms in contact, and confequently acting in oppofition to each other. Now, the force with which each of the mediums acts on the green ray, is reprefented by fix; the difference between which being nothing, the green ray will proceed in its rectilineal courfe, as it would do in the fame uniform medium.

But as the red ray is attracted by the crown-glafs with a force reprefented by five, and by the difperfive medium with a force equal only to four, it will, in paffing out of the former into the latter, be deflected towards the crown-glafs, by the difference between thefe forces, which is equal to unity.

The violet ray, on the contrary, is attracted by the crown-glafs with the force feven, and by the difperfive medium with the force eight, and will therefore be refracted towards the latter, in the fame degree in which the red ray is refracted from it, as reprefented in the figure. It is a circumftance worth remarking, that a particle of red light, and a particle of violet light, under precifely the fame circumftances of expofure to the action of grofs bodies, fhould be urged in contrary directions.

I have tried thefe feveral cafes of refraction likewife with compound object-glaffes, which fhew the effect better than the prifms. Thus, if a plano-convex lens have its plane fide turned

ed towards a diſtant object, the rays will enter it, as to ſenſe, perpendicularly, and will therefore ſuffer no refraction. If the convex ſurface of this lens be brought in contact, with a fluid of leſs mean refractive denſity than the glaſs, but exceeding it in diſperſive power, in that degree which occaſions an equal refraction of all the rays, all theſe rays will then be converged to the ſame point, which are incident at the ſame diſtance from the axis of the lens. The focal diſtance of this compound lens will be greater or leſs in proportion to its radius of convexity, and to the difference of refraction between it and the fluid made uſe of. While the fluid is confined on one ſide by the plano-convex lens, let the lens which is brought in contact with it on the oppoſite ſide, have one of its ſides ground convex, and the other concave; the radii of their ſphericities being equal to the focal diſtance at which the rays are made to converge, by the refraction which takes place, when light paſſes from the plano-convex lens into the fluid. It is manifeſt that the light will now both enter into this compound lens, and emerge from it perpendicularly, and will therefore ſuffer no refraction, except in the confine of the convex ſide of the plano-convex and the diſperſive fluid, where all the rays are equally refrangible. A compound lens of this kind, is repreſented in the ninth figure, which, after what has been ſaid, will require no farther explanation; excepting only, that inſtead of being ſpherical, it is repreſented with that curvature which converges homogeneal rays, incident at all diſtances from the axis, to the ſame point. If the required curvature could be given to lenſes with ſufficient accuracy, this figure ſeems to repreſent as perfect a conſtruction of the object-glaſs of a teleſcope as can be deſired. But there is reaſon to think that a ſpherical figure may be communicated, not only much eaſier, but with greater accuracy than a ſpheroidal or hyperboloidal, which would be required; and even if this difficulty could be got over, there would ſtill remain a fundamental fault in the theory. Before relating the

 obſervations

obſervations by which this was detected, it will be requiſite to explain the method of removing the ſpherical aberration, by a combination of convex and concave lenſes. For next to the indiſtinctneſs ariſing from the unequal refrangibility of light, this aberration, occaſioned by the ſpherical figures of lenſes, is the great obſtacle to the advancement of the powers of viſion.

Of the aberration from the ſpherical figure.

THIS ſubject has been treated of in all the variety of caſes which can occur in ſingle glaſs lenſes, by the great HUGENIUS, in his Dioptrics, a poſthumous work. He there demonſtrates that the quantity of this aberration is very different in different lenſes of the ſame focal diſtance, according to the convexities or concavities of their two ſides, and the manner in which theſe are expoſed to parallel rays.

IN convex lenſes, thoſe rays which paſs at a diſtance from the axis, are converged to a point nearer to the lens than its geometrical focus. The diſtance between the point at which the external ray of a pencil incident on a lens, interſects its axis and the geometrical focus, is called the linear aberration of that lens.

HUGENIUS demonſtrates, that when a plano-convex lens is expoſed to parallel rays, with its plane ſide towards them, this aberration will amount to four times and a half the thickneſs of the glaſs. By the thickneſs of a convex lens is meant its greateſt thickneſs in the middle, after ſubtracting its thickneſs, if it has any, at the outer edge; and by the thickneſs of a concave lens, is meant its thickneſs at the external edge, after deducting its thickneſs in the middle.

ON turning the convex ſide of the lens towards the light, the linear aberration will only exceed the thickneſs of the lens by one ſixth part.

WHEN

When both ſides of a lens are convex, and the proportion of their convexities is as one to ſix, if the moſt convex ſide be expoſed to parallel rays, the aberration will exceed the thickneſs of the lens one fourteenth, which is the ſmalleſt poſſible aberration of any convex lens.

If it is required to increaſe the aberration, this may be done by grinding one ſide of the lens convex, and the other ſide concave, to a longer radius. Such a lens, with its concave ſide turned towards parallel rays, will have more aberration than any plano-convex or double convex lens of the ſame focal diſtance.

Hugenius proceeds to ſhew, that the ſame aberration is produced by concave lenſes as by ſimilar convex ones. When a plano-concave lens is expoſed to parallel rays, with its plane ſide outward, the external ray of the pencil, being produced backward after refraction, will interſect the axis of the lens nearer to it than its focus, by four times and a half the thickneſs of the lens. But if its concave ſide be expoſed to the parallel rays, the aberration will only exceed the thickneſs of the lens one fourteenth part. A double concave, whoſe radii are as one to ſix, with the moſt concave ſide turned outward, diſperſes the rays with the leaſt aberration; and a concave meniſcus, with its convex ſide outward, produces more aberration than any plano-concave or double concave lens, of an equal focal diſtance.

These are ſufficient data for correcting the aberration from the ſpherical figure, in caſes where both a convex and concave lens are required, in the conſtruction of the compound object-glaſs.

Fig. 10. Let AB repreſent a convex lens receiving a pencil of rays from the object S, and converging rays incident near the axis, as S T, to the point F; and external rays, as S B, to the point

D; ſo that D F repreſents the greateſt linear aberration in this caſe.

Again, let G H (Fig. 11.) repreſent a concave lens, receiving the parallel rays S H, R K, which it refracts in the lines H X and KV. This ray KV being produced backward, will interſect the axis of the lens nearly at the point N, which is called the virtual focus of the concave; and the external ray H X produced backward, will interſect the axis in ſome point P nearer to the lens than its focus, P N being the linear aberration.

It may here be obſerved, that the convex is in that poſition which produces the leaſt aberration, and the concave in the poſition which produces moſt aberration. Hence, to render the aberrations D F (Fig. 10.) and P N (Fig. 11.) equal, the focal diſtance of the convex muſt be much ſhorter than that of the concave; and if the diſtances of the points F and N from the convex and concave lenſes be required to be the ſame, as repreſented in the figures, then muſt the object be placed much nearer to the convex. Hence the image of the near object S, is repreſented at the ſame diſtance from the convex lens in figure tenth, as the virtual focus of the concave in figure eleventh, where it is repreſented as receiving parallel rays, which are ſuppoſed to come from an infinitely diſtant object.

Now, when the diſtance between K and N, which is the point from which parallel rays are made to diverge by the concave lens, is equal to the diſtance between T and F, which is the point to which rays iſſuing from S are made to converge by the convex; and when the aberrations D F and P N are alſo equal; I ſay, that in this caſe, if the two lenſes be placed contiguous, in the manner repreſented in the twelfth figure, parallel rays, incident on theſe lenſes, will be converged to the point S, without any aberration of the external ray.

For

For it is an axiom in optics, that if a ray of light after refraction be returned directly back to the point of incidence, it will be refracted in the line which was before described by the incident ray.

If therefore we conceive the whole of the light emitted from the point S (Fig. 10.), and converged by the convex lens towards the points D and F, to be returned directly back from these points, it will be accurately converged to the point S, whence it issued. Now, the parallel rays S H, R K, (Fig. 11.) after their emergence from the concave lens, in the lines H X, K V, are precisely in the same relative situation, as the rays supposed to be returned directly back from F and D are in, at their incidence on the convex; and therefore, when these lenses are placed contiguous, in the manner represented in the twelfth figure, parallel rays incident on the concave lens, and immediately after their emergence from it, entering the convex lens, will be accurately converged to the point S, without any aberration.

This, which is the most simple case, will suffice to explain the nature of that aberration, which arises from the spherical figures of lenses, and a method of obviating it by combining a convex and concave.

The demonstration is perfect as far as regards the external ray, which is here represented passing from the external part of the concave into the external part of the convex, in immediate contact with it; and if the surfaces of the two lenses, which respect each other, were either in contact or parallel, it would be true with regard to all the rays. But as this is not the case, there arises a small secondary aberration, the effect of which only becomes sensible in large apertures.

Hence may be understood the reason why the indistinctness arising from the spherical figures of lenses, may, in the common achromatic telescope, be more nearly removed in those constructions of object-glasses in which three lenses are employed,

ployed, than in thofe compofed only of two ; and alfo the advantages in this refpect, which may be derived from introducing fluid mediums, which differ from glafs in their mean refractive denfity, and in the quantity of aberration produced by their refractions. For it will be found upon computation, that when the fluid medium is rarer than glafs, the aberration from the fpherical figure is increafed, and becomes greater in proportion as its denfity diminifhes. Now, by making the denfity of the fluid medium approach nearer and nearer to the denfity of the glafs with which it is in contact, we may increafe the rarity of our refracting medium, or, which amounts precifely to the fame thing, diminifh the difference of denfity of the two mediums at pleafure.

It will appear from what has been explained, that the aberration from the figure cannot be corrected by interpofing a difperfive fluid between two convex lenfes, of a greater refractive denfity than the interpofed fluid. For all the refractions being made the fame way, tend to converge the external rays to points nearer the lens than its geometrical focus. Hence, when rare fluids are made ufe of to remove the aberration from the difference of refrangibility, fome farther contrivance becomes neceffary to correct the fpherical aberration.

The moft obvious way, and which on trial I found fuccefsful, is to include the rare difperfive fluid between two glaffes, ground concave on one fide and convex on the other, and thus form fuch a concave as fhall be required. By combining this with a convex, an achromatic object-glafs may be formed, as reprefented in the fixteenth figure. The objection to this conftruction is, that one of the advantages arifing from the ufe of fluids is given up, namely, the prevention of that lofs of light by reflection, which is a confequence of the fluid being in immediate contact with the glafs, whereas in the prefent cafe, the fpace between the convex and concave is occupied by air.

On

On this account I attempted to introduce a third medium, by filling this vacancy with a fluid of the leaſt diſperſive kind, and of leſs mean refractive denſity than the diſperſive fluid. For this purpoſe I employed ſometimes rectified ſpirit of wine, and ſometimes vitriolic æther; and by giving to the lenſes the proper degree of curvature, in which great variety may be introduced, I ſucceeded in forming object-glaſſes, in which both aberrations are removed, and hardly any more light loſt than in a ſimple object-glaſs.

Having gained this point, I now determined to try how far the aperture of the object-glaſs might be increaſed, without increaſing its focal length, expecting, at leaſt, to equal reflectors in this reſpect. But the firſt trials to execute object-glaſſes on this principle, though they left no reaſon to complain of want of ſucceſs, when compared with ſuch inſtruments as are now in uſe, ſurpriſed me with new phenomena, and new obſtacles to the perfection of the theory of teleſcopes, more unaccountable and perplexing than any I had before encountered. Theſe I ſhall now proceed to give an account of.

Of the imperfect correction of priſmatic colour which is obtained by a combination of mediums of different diſperſive powers.

I took a compound object-glaſs of the conſtruction laſt mentioned, compoſed of three lenſes, two of them plano-convex and the other a meniſcus. The radius of convexity of one of the plano-convex lenſes is about four inches, and the convex ſide is turned towards the object. The radii to which both ſides of the meniſcus are ground, are about five inches, one ſide being convex and the other ſide concave. The concave ſide is made to reſpect the plane ſide of the above mentioned plano-convex, and the vacancy between them is filled with vitriolic æther. The third plano-convex lens is ground to a radius of ſix inches. Its convex ſide is turned towards the convex ſide of

the

the menifcus, and the vacancy between them is replenifhed by a fluid of the requifite degree of difperfive power, which is confined by means of a ring of glafs. Thefe lenfes are two inches and feven eighths of an inch in diameter, and the focal length of the compound object-glafs is ten inches; the curvatures of the lenfes being fo proportioned, as nearly to correct the aberration from the fpherical figure.

The fluid I employed to remove the colour arifing from the different refrangibility of light, was an effential oil, whofe difperfive quality I could eafily increafe or diminifh, by mixing it with others differing in their difperfive qualities, though of nearly the fame mean refractive denfity; by which means, the correction of the error from the figure was not difturbed, by varying the ftrength of the difperfive fluid. I now expected perfectly to remove the colour, by adding a little of one or other of the difperfive fluids, as occafion might require.

Before relating the event of this trial, it will be proper to explain the manner of examining the difperfive power of fluids by means of lenfes, and of diftinguifhing when the colour is perfectly corrected.

When the image of a lucid point is formed in the focus of a fimple lens, the violet rays are converged to a focus neareft to the lens, and the deep red rays are converged to a focus at the greateft diftance from it. The confequence of this is, that if this image be examined by an eye-glafs nearer to the lens than is required for diftinct vifion, it will appear furrounded with a red fringe, which is the prevailing colour of the leaft refrangible rays; and if the eye-glafs be placed at a diftance beyond that which is required for diftinct vifion, it will be furrounded with a blue fringe, which is the prevailing colour of the moft refrangible rays.

The reafon of this will appear more clearly from infpecting the thirteenth figure, where the red rays appear outermoft within the focus at A, and the violet rays appear outermoft beyond

yond the focus at B. Theſe colours may alſo be ſeen, when an image of any luminous object, as the ſun, is formed by a lens upon a white ground; and they will be ſo much the more conſpicuous, by how much the diameter of the lens is greater, in proportion to its focal diſtance.

Just the reverſe of this will happen in a compound object-glaſs, if, in correcting the colour, the medium employed diſperſes more than it ought to do. A blue fringe will then appear round a luminous object, when the eye-glaſs is puſhed in; and a red fringe, when it is drawn out beyond what is neceſſary for diſtinct viſion.

In this way, the correction of the colour may be examined, and the qualities of refracting mediums inveſtigated, to an extreme degree of accuracy; yet the effect will be rendered ſtill more ſenſible, by covering half the object-glaſs. For when this is done, the colour produced by the uncovered half of the object glaſs appears, without being mixed with that of the oppoſite ſide, even when the eye-glaſs is adjuſted to diſtinct viſion. Thus, in Fig. 13. the colours produced by both ſides of the lens, are mixed at the general focus F. But if the rays coming from one ſide be intercepted, thoſe which are refracted by the other ſide will appear in their proper colours. By theſe means, and by employing a very luminous object, ſurrounded by a dark ground, and a high magnifying power, the leaſt uncorrected colour may be rendered ſenſible.

My firſt obſervations, which clearly proved the correction of colour which is obtained by the combination of two mediums differing in diſperſive power, to be only partial, were made in the ſummer of the year 1787, at Merchiſton.

I had, ſome time before, found it impoſſible to ſucceed, in this reſpect, with priſms compoſed of crown and flint glaſs. But as I neither was able to make the phenomena ſo apparent by this method as with lenſes, nor had a command of priſms with that great variety of refracting angles neceſſary to put it

beyond all doubt, that the colour obſerved might not proceed from the angles of the priſms not being preciſely thoſe, which would render the correction of colour moſt perfect, I paid no farther attention to the ſubject at that time.

In examining the object-glaſs above mentioned, the object obſerved was a ſmall window in a white wall, at the diſtance of ſeveral hundred yards to the eaſtward of my ſtation, the ſun ſhining upon the wall from the weſt. The circumſtances of the phenomena, which I have extracted from memorandums written at the time of making the experiments, were as follow:

"*July* 28. 1787. In conſtruction A, (by this is meant the ten inch object-glaſs above deſcribed), when rendered as achromatic as poſſible, a purpliſh light appears on one ſide the focus, and a greeniſh light on the other."

In the next obſervation of this kind of incorrigible colour, the flame of Argand's lamp was uſed as an object, the great brilliancy of its light rendering the phenomena more conſpicuous. A cylinder of braſs was placed over the glaſs-tube, which intercepted all the light, excepting what paſſed through a ſmall round hole oppoſite to the flame. I found no object preferable to this for the purpoſe, except the planet Venus, which cannot always be commanded. My obſervation mentions, that "with the patent lamp, the colour is deep carmine within the focus, and greeniſh yellow without it."

Another memorandum on this ſubject runs thus: "Conſtruction 10. (by this is meant another object-glaſs, compoſed, like the former, of crown-glaſs, an eſſential oil, and ſpirit of wine, inſtead of æther, but a few inches longer than it, and more perfect) diſcovers a great deal of colour of ſome kind, in covering half the object-glaſs. The object, though coloured, is then more diſtinct than upon uncovering the other half; the colour is thus converted into miſtineſs. On altering the diſperſion of the fluid, the colour on one ſide alters from purpliſh violet

violet to reddiſh violet, and on the other from greeniſh orange to greeniſh blue. As the diſperſion is diminiſhed, the red gains on the violet within the focus, and the greeniſh blue upon the orange without it, and *vice verſa*; and there is a conſiderable latitude, within which, varying the diſperſion, makes little difference in the diſtinctneſs."

As this laſt obſervation put it beyond doubt that an inveſtigation of the cauſe of theſe appearances was of the laſt importance to the improvement of optics, I now began to reaſon concerning them.

THE firſt conjecture that offered was, that this colour might ſomehow proceed from the ſurfaces of the convex glaſs lenſes, and the concave lenſes of diſperſive fluids, not correſponding at different diſtances from the centre, as the plane ſurfaces of priſms every where do. In order to examine what effect this might have, I procured two pieces of plate-braſs, with which I could cover the whole of the object-glaſs; and out of one of theſe I cauſed a ring, of a quarter of an inch in breadth, to be cut towards the centre, and out of the other, a ring of the ſame breadth, cloſe to the circumference. For I perceived that, if the colour aroſe from the cauſe above mentioned, its appearance ought to be different through theſe two rings, when there is an accurate correction of colour in that part of the object-glaſs, which is equi-diſtant from the centre and the circumference. But upon trying the experiment, the ſame purple and green colour appeared through both theſe rings, as through the whole object-glaſs, and the colours lay in the ſame order in both caſes. My remark upon this experiment is in the following words: " Upon trying with a ring either external or internal, the appearances remain the ſame, as when the whole aperture is uſed; which ſeems to prove that this colour ariſes from the diſperſion not being proportional, and not, as was ſuppoſed, from the ſurfaces not correſponding. It is evidently the greateſt bar to increaſing the aperture, and giving high powers; there

is only a partial correction of colour; the differently refrangible rays cannot all be converged to one focus."

The next method that occurred to me of determining the point in question was more decisive. This was to observe whether any of this green and purple colour appeared through the most perfect kind of achromatic object-glass above described, and represented in the ninth figure, in which there is only one refraction. This I found to be the case; and therefore considered myself as in possession of sufficient authority for concluding, that the theory advanced by Mr Dollond, and generally received, was defective. For with the large aperture and high power made use of in these experiments, the colour that appears in viewing a bright object is not weak and hardly sensible, but a beautiful bright purple inclining to crimson and a strong full green, and these in such a quantity as evidently to be the obstacle to increasing the aperture of the object-glass.

This was the conclusion I was then led to, and which I have found confirmed by numerous experiments made since. But before entering farther on the subject, it will be necessary to explain what is meant by different mediums not dispersing the heterogeneal rays of light proportionally.

Let A B and C D (Figures 14. and 15.) represent the surfaces of two mediums, both of which equally refract the mean refrangible ray. This we shall suppose to be the green ray, though, in this explication, it is not material which is called the mean refrangible ray. The angles of incidence K G L, M R N, will then be equal, and the angles of refraction of the green ray H G g, P R γ, will also be equal in both these mediums.

Let one of these mediums C D exceed the other A B so much in dispersive power, as to make the difference of the angles of refraction of the green ray, and extreme violet ray, in the medium C D, double of what it is in the medium A B; that is to say, the angle υ R γ double the angle ν G g. Then if

if the difference of the angles of refraction of the green ray and deep red ray, in the medium C D, be alſo double of the difference of the angles of refraction of theſe rays in the medium AB, that is to ſay, the angle $\gamma R \varrho$ double the angle $g G r$; I ſhould ſay that the two mediums diſperſed theſe three kinds of rays, namely the red, green and violet rays proportionally. But if, when the difference between the angles of refraction of the green ray, and extreme violet ray, in the medium C D, is double of what it is in the medium A B; the difference of the angles of refraction of the green ray, and deep red ray in the medium C D, ſhall be found to exceed the difference between the angles of refraction of theſe rays, in the medium A B, only one half, for example; then I would ſay that the two mediums do not diſperſe theſe differently refrangible rays proportionally.

For in this caſe the medium C D diſperſes or ſeparates the green ray, and extreme violet ray, twice as much as the medium A B does; whereas the ſeparation of the green ray, and deep red ray, in this ſame medium C D, exceeds only by one half their ſeparation in the medium A B.

It is farther manifeſt, that the red, green and violet rays cannot be rendered parallel by any combination of the refractions of the two mediums, upon the laſt mentioned ſuppoſition. The whole refraction, through a priſm compoſed of the medium C D, may be ſuch as to give exactly the ſame inclination of the red and violet rays, which a priſm compoſed of the medium A B does, when both rays ſuffer a greater refraction through the latter; and therefore both theſe rays may be equally refracted and converged to the ſame point by means of a convex lens of the leaſt diſperſive medium AB, and a concave lens duly proportioned to it, formed of the moſt diſperſive medium C D.

But if we now add to theſe the green ray, it is evident that it too cannot be refracted parallel with the red and violet rays.

For

For when the whole refraction of the leaft difperfive medium AB is fuch as juft to unite the red and violet rays, the green ray, which is more refracted by this medium A B, in proportion to the whole refraction of the red and violet rays in the medium A B, than it is refracted by the difperfive medium C D, in proportion to the whole refraction of the red and violet rays in the medium C D, will, when the red and violet rays are united by contrary refractions through thefe two mediums, be refracted too much ; the balance of refraction being always, in this cafe, in favour of the leaft difperfive medium ; and therefore the green light will emerge from this compound refraction more refracted than the united red and violet light, and the inclination of the emergent green light to the emergent united red and violet light, will be greater or lefs according as the ratio in which the red, green and violet light are feparated by the refraction of the two mediums, approaches more or lefs to equality. What this inclination amounts to, in any particular inftance, muft be determined by experiment.

Hence if the cafe of unproportional difperfion, above ftated, fhould be found to hold true in fact, we fhall arrive at this new truth in optics, That though in the refraction of a pencil of folar light, made in the confine of any medium, and a vacuum, the deep red rays are always the leaft refrangible, and the violet rays are always the moft refrangible ; yet it depends entirely on the fpecific qualities of the medium, which fhall be the mean refrangible ray ; the very fame ray, which in the refraction through one medium is the mean refrangible ray, being found in others among the lefs refrangible rays. For it is manifeft that the ray which bifects the angle formed by the moft and leaft refrangible rays, and falls in the middle of the coloured fpectrum, is to be accounted the mean refrangible ray.

Thus, in Fig. 14. the green ray Gg is the mean refrangible. But in Fig. 15. the green ray Rγ is found among the

lefs

lefs refrangible rays, and fome other ray, Rω, which is one of the more refrangible rays in the medium AB, is the mean refrangible ray in this medium CD.

The moft obvious way of examining the optical properties of different mediums, is by means of prifms. But I have not found this method either fo eafy or fo accurate as that by means of lenfes, which has been already explained. It has been fhewn, that the image of a lucid point (fee the thirteenth figure) is every where, between the lens and that point where the rays crofs, furrounded with a fringe of the colour of the leaft refrangible rays; and that every where beyond the point of croffing, the image is furrounded with a fringe of the colour of the moft refrangible rays; and that thefe colours appear more diftinctly at the focus itfelf, when one half of the lens is covered. Hence, in order to determine which rays are the moft or leaft refrangible, after refraction through any lens, whether fimple orc ompound, it is only neceffary to examine the colours of thefe fringes, which is the more eafily done, as they are greatly magnified by the eye-glafs.

In fingle lenfes, the fringe within the focus, which is compofed of the leaft refrangible rays, will always be found to be of a red colour, with a mixture of orange; and the fringe beyond the focus, compofed of the moft refrangible rays, will be found to be of a blue colour. Thefe are the colours which, it is well known, are produced by fimple refraction, made in the confine of every known medium and a vacuum.

From what hath been already related, it appears, that colour is likewife produced in what has been termed achromatic refraction, though it be lefs in quantity, in proportion to the whole refraction; and the rays which are found moft and leaft refrangible, in thefe two cafes, differ very widely.

In a compound object-glafs, formed of a concave, which difperfes the rays in a greater degree, and a convex, which difperfes the rays in a lefs degree, there was always found, when the

the correction of colour was rendered the moſt perfect poſſible, a fringe of purple within the focus, and a fringe of green beyond the focus; and theſe coloured fringes appeared, whether the concave conſiſted of flint-glaſs, or of an eſſential oil. Therefore, in this kind of compound refraction, the rays of light, when their union is rendered the moſt perfect poſſible, emerge differently refrangible; and the rays which emerge moſt refrangible, have the property of exciting in us the idea of a green colour; and the rays which emerge leaſt refrangible, have the property of exciting in us the idea of a purple colour.

When, for the ſake of brevity, I ſpeak here, or elſewhere, of the union of the red and violet rays, as if it were performed by a ſingle refraction, whereas, in general, the moſt that can be effected is to render them parallel by oppoſite refractions, I would be underſtood to refer to the moſt ſimple and perfect caſe of achromatic refraction, in which the extreme red and violet rays are really equally refracted, and conſequently united, by a ſingle refraction, as already explained in the references to the fifth and ninth figures.

The fringe of purple light is formed in part by an union of the red and violet rays, which in ſimple refraction differ moſt in refrangibility, but which are here equally refrangible; and partly of the united orange and indigo light, which are alſo united, and form the ſecond order of coloured light in this ſecondary ſpectrum.

The green fringe is compoſed in part of the homogeneal green rays, which, in common refraction, are the mean refrangible, or nearly ſo, but are now the moſt refrangible of all. The remainder of this green fringe is formed by an union of the yellow and blue rays, compoſing what may be termed an heterogeneal green.

It will appear from the foregoing ſtatements, in what manner this diſpoſition of the rays is a neceſſary conſequence of the

the concave and convex lenſes being compoſed of mediums which do not diſperſe the rays proportionally, as before explained. But the matter will be beſt underſtood, by recurring to the caſe above mentioned, of ſingle achromatic refraction. Thus I continue to denominate it, though the Society will perceive that this term *achromatic*, is here uſed with manifeſt impropriety; and will alſo make proper allowance for the ſenſe in which I have employed the term *homogeneal light*, in conformity to the common language of optics.

It was formerly aſſerted, that when two mediums differ in mean refractive denſity, and the diſperſive power of the rare medium exceeds that of the denſe medium in a certain proportion, light of all colours will be equally refracted in the confine of the two mediums; and it is true that the red and violet rays will be equally refracted, and the rays of other colours as nearly ſo as by any combination of two mediums of different diſperſive powers. But on account of the two mediums not attracting, and conſequently ſeparating the rays of different colours in a given ratio, the ſame green and purple-coloured fringes appear in an object-glaſs of this kind, as in one in which oppoſite refractions are employed; ſo that in the refraction which takes place in the confine of two ſuch mediums, the rays of light are ſtill unequally refrangible. But inſtead of the degree of refrangibility being, as in common refraction, according to the order of the colours, red, orange, yellow, green, blue, indigo, violet, the priſmatic ſpectrum is, as it were, doubled, the rays being, at the ſame time, compreſſed nearer to each other; and their degrees of refrangibility being now according to the following order: Red and violet united, the leaſt refrangible; next to theſe in refrangibility, the orange and indigo united; then the united yellow and blue; and, laſtly, the homogeneal green rays, which are the moſt refrangible.

Of the perfect correction of the aberration arising from the unequal refrangibility of light.

This fact now eſtabliſhed on the fulleſt evidence, that the divergency of the heterogeneal rays is not to be removed by a combination of crown-glaſs with flint-glaſs, or with thoſe diſperſive fluids employed in the object-glaſſes, with which the experiments above related were made, diſcovered a moſt important problem in optics, namely, the entire removal of the aberration from the difference of refrangibility of light, by any combination of mediums whatever.

This problem, it was evident, was only to be attempted by again having recourſe to the volume of nature, and ſearching out the hidden qualities of refracting mediums. Though in all the compound object-glaſſes which were examined, after being rendered as achromatic as poſſible, the ſame colours appeared, and in the ſame order; yet every trial could only be conſidered as ſpeaking for itſelf, if the expreſſion may be allowed. The experiments were indeed numerous, and will, I hope, be found to have been made with ſufficient care and attention; yet to have formed from them any general concluſion, that in every endeavour to unite the rays of all colours, by a combination of mediums differing in diſperſive power, the green rays will emerge moſt refracted, and the red and violet leaſt refracted, as above explained, could only ſerve to prevent farther inveſtigation, by repreſenting the perfection of the theory of optical inſtruments by refraction as a deſperate attempt.

The order in which I proceeded farther to explore this ſubject was the following:

Having found fringes of colour, as above deſcribed, in combinations of crown-glaſs with the eſſential oils, and in combinations of crown-glaſs and flint-glaſs, when the refraction is rendered

rendered as colourlefs as poffible, I began by trying other difperfive mediums, which owe this property to different metallic or faline particles with which they are impregnated, in hopes of finding fome difperfive medium, which might feparate the differently refrangible rays in the fame proportion in which crown-glafs does, and thus afford a method of refracting all of them alike, and confequently without colour. But I was difappointed. The compound object-glaffes, formed of a variety of difperfive fluids and crown-glafs, exhibited green and purple fringes, as before, which proved the difperfive power of the two mediums not to be proportional.

My next ftep was to vary the combination by rejecting glafs entirely as a refracting medium, and only employing it to confine the fluids. As a fluid medium was here to be ufed as a convex lens, thofe which had been found leaft difperfive, were to be made choice of. Accordingly, water, fpirit of wine, nitrous and vitriolic æther, and all the limpid indifperfive fluids I could come at, were made trial of. But ftill the refult was the fame. The green and purple fringes appeared, on covering half the object-glafs.

I THEN fubftituted fome other of the more perfect indifperfive kinds of glafs inftead of crown-glafs; but with no better fuccefs.

NEXT I combined two effential oils, both of them more difperfive than crown-glafs, but differing fo confiderably in this refpect between themfelves, that the lefs difperfive could be ufed as a convex, while the other was fo difpofed as to perform the office of a concave. For it will eafily be underftood, that lenfes of any kind may be formed of fluid mediums, by including them between glaffes, which have one fide formed convex, and the other concave, to the fame radius, and thus ferve merely to confine the fluids, without producing themfelves any effect in refracting the light. If a flat fide is wanted, a piece of plain glafs with parallel fides muft be ufed, and in

concave lenſes of this kind, the farther contrivance of a glaſs-ring to confine the fluid is required.

The effect of the above combination, which was of oil of turpentine with a mineral oil, I immediately perceived to be different from what was obſerved in the preceding trials. The green and purple fringes ſtill appeared, and they lay in the ſame order as before; but their breadth was greatly diminiſhed, I judged about one half.

This new fact was the only fruit of this laſt ſet of experiments, which were attended with much trouble and loſs of time. For to make them with the requiſite degree of preciſion, pains muſt be taken, not only to get the refraction as colourleſs as the qualities of the mediums will admit, but alſo to compute the error from the ſpherical figure, and procure lenſes accurately ground to the ſpheres which are required. Unleſs theſe points are duly attended to, accuracy in the reſults is not to be expected.

I now conſidered how this diminution of the breadth of the coloured fringes, obſerved in the laſt mentioned experiment, might beſt be turned to account. In the firſt place, it was obvious, that an object-glaſs, formed by a combination of the mediums uſed in that experiment, would have an advantage over others, in which the correction of the aberration from the difference of refrangibility is more imperfect. But as this fault, though greatly diminiſhed, would ſtill prevent the uſe of high magnifying powers, I weighed the circumſtances more attentively, and the matter appeared to me in the following light:

A convex lens, formed of the leaſt diſperſive of the two eſſential oils, being ſo combined with a concave lens, formed of that which is moſt diſperſive, as to unite the red and violet rays, leaves fringes of uncorrected colour, much narrower than thoſe produced by compound object-glaſſes of the ſame focal diſtance, formed by a combination of either of theſe fluids

with

with glaſs. Hence I was led to conclude, that if I took an achromatic convex lens, compoſed of the two eſſential oils, and combined it with an achromatic concave lens of a longer focal diſtance, compoſed of crown-glaſs and either of the eſſential oils, I ſhould be able, through ſuch a double compound object-glaſs, to converge the rays to a focus, without any aberration whatever from the difference of refrangibility of light. For if the compound convex and compound concave are properly proportioned to each other, the ſecondary ſpectrums, or fringes of green and purple, may be rendered of the ſame breadth in both lenſes; and from the obſervations before related, this will happen when there is a conſiderable balance of refraction in favour of the convex lens. For it is compoſed of materials which form a much narrower ſecondary ſpectrum, under an equal refraction of the whole pencil, than thoſe mediums do, of which the compound concave is formed.

THIS will be underſtood, by attending to what takes place in the refractions of light through the lenſes, without again recurring to the more ſimple caſe of priſms.

FIG. 17. repreſents a compound concave lens, formed of a concave lens of glaſs, and a concave lens of a diſperſive fluid, but of a ſhorter focus than the concave lens, and ſo proportioned as to produce a refraction as free from colour as can be obtained by a combination of theſe two mediums. This lens being expoſed to parallel rays, will make them diverge, after refraction, from its virtual focus, and the united red and violet rays will be the leaſt refracted, and will be inclined in a certain angle to the green rays which are moſt refracted, as repreſented in the figure.

FIG. 18. repreſents a compound convex lens, formed of a convex of an eſſential oil, which diſperſes the rays in a leſſer degree, combined with a concave of an eſſential oil,

which

which difperfes the rays in a much greater degree. The convexity of this compound lens is fuch, as to unite, at a convenient diftance, rays diverging as from the virtual focus of the compound concave. The whole refraction through the convex is confequently much greater than through the concave. But notwithftanding this, the angle formed by the green ray with the united red and violet rays, is reprefented equal in the two lenfes. For as the effect of the mediums of which the compound concave is formed, is to feparate the united red and violet rays from the green rays, much more than thofe of which the compound convex is formed, when the refraction of the pencil is equal, it becomes neceffary, in order to render this feparation equal in both lenfes, to diminifh the refraction through the concave.

An object-glafs formed of fuch a compound concave and compound convex, appears more complicated than it is in reality. It may be rendered complete without employing more than two fluid mediums and three glafs lenfes, which were found neceffary merely to correct the aberration from the fpherical figure. Thus, in the nineteenth figure, the two compound lenfes are reprefented in contact; and it is manifeft, that the pieces of plain glafs with parallel fides, which were neceffary to confine the fluid when the lenfes were feparate, are now ufelefs; for it is the very fame fluid which is on both fides of thefe plain pieces of glafs; and as they produce no effect in refracting the light, they are better removed, as reprefented in this figure.

Parallel rays incident on the concave lens, are here reprefented converged to a focus, without any aberration whatever. This is a neceffary confequence of what hath been related concerning the properties of the refracting mediums, of which this compound object-glafs is formed.

In both the concave and convex, the red and violet rays are united, and form the leaft refrangible rays, and in both, the green

green rays are the moſt refrangible. But as the angle formed by theſe moſt and leaſt refrangible rays, would be much greater in the concave if the whole refractions were equal, the whole refraction is here repreſented to be preciſely that which is requiſite for giving the ſame inclination of the green rays to the united red and violet rays, which takes place after refraction through the convex. Hence, as theſe refractions are equal and oppoſite, they deſtroy each others effect. The rays proceed after refraction without any divergency from unequal refrangibility; and the aberration from the ſpherical figure being alſo corrected by means of the concave glaſs lens, which is more denſe than either of the fluids, they are converged to the ſame point.

THE conſtruction repreſented in theſe figures, is not, however, the moſt perfect and convenient for the purpoſe. The beſt method is to divide the concave glaſs neceſſary for removing the ſecondary colour, by making two of the lenſes, or all three of them, concave meniſcuſes. But throwing the whole concave glaſs into one lens, and exhibiting the compound convex and compound concave lenſes ſeparately, anſwers beſt the preſent purpoſe of explaining the principle on which the aberration from unequal refrangibility may be totally removed. On the ſame account, the difference of the diſperſive power of the two fluids, is repreſented greater than it is in reality.

HAVING completed an object-glaſs of this kind, I carefully examined whether any colour was yet diſcernible. For though the red and violet and green rays were now united, it was a thing poſſible, that rays of other colours might ſtill have a ſmall inclination to theſe. But I could diſcover no colour by the moſt rigid teſt; and therefore conclude the refraction of all the rays of the ſpectrum to be now equal. If there be any deviation from this equality of refraction, it is inſenſible; and inſenſible errors, in thoſe caſes where ſenſe is the only judge, may be accounted no errors at all.

I HAD now attained the object I was in ſearch of, namely, a method of refracting equally all the rays of which light is compoſed. Nor was the conſtruction of object-glaſſes for teleſcopes, which it afforded, liable to any very material objection. The principal inconvenience aroſe from the neceſſary depth of the ſpheres of the lenſes required, which was now the only remaining obſtacle to ſhortening the refracting teleſcope at pleaſure.

IN the firſt trials I made to diſcover a diſperſive medium which ſhould ſeparate the rays in the ſame proportion in which glaſs does, I was in hopes of perfect ſucceſs, and therefore not at all curious in obſerving the breadths of the coloured fringes, ſtill hoping that the next trial might afford a refraction without any colour whatever. I therefore thought it expedient to repeat ſome of them, with greater attention to that circumſtance.

THE firſt fluid I happened to make trial of, was a metallic ſolution with a mixture of marine acid. Upon comparing an object-glaſs, rendered achromatic by this ſolution, with another as nearly ſimilar to it as poſſible, in which an eſſential oil was employed for that purpoſe, the breadth of the coloured fringes appeared indiſputably much narrower in the former than the latter *. I repeated the experiment frequently, to enable me to judge of the proportion of focal diſtance of a compound concave, neceſſary to correct this ſecondary colour, upon the principle which hath juſt been explained. Upon a comparative trial, I found it better to form the compound convex of a combination of this fluid and glaſs, than of a combination of two eſſential oils. The convex was not only ſhorter itſelf, with the ſame depth of ſpheres, but required a ſhallower compound concave

* THE cauſe, at that time unknown, was, that the ſolution happened to contain an unuſual proportion of the marine acid; as will be underſtood from what follows.

concave lens to remove the colour entirely. The colour may be totally removed, and the aberration from the figure corrected, by a concave which lengthens the focal diſtance of the convex only one third.

FROM what hath been explained reſpecting the total correction of colour, it will be underſtood, that if the concave lengthens the focal diſtance beyond what is required, fringes of green and purple ought to begin to appear in an inverted order. This, which may be ſtyled the *experimentum crucis* in this matter, I now had it in my power to try without difficulty. The reſult turned out exactly as I expected. Upon applying a compound concave, which nearly doubled the length of the compound convex, a fringe of green appeared within the focus, and a fringe of purple beyond it, which ſets the theory of the correction of this ſecondary colour in the moſt ſatisfactory light.

THE compound concave in this and all the preceding experiments, was formed of glaſs and an eſſential oil.

I NOW happened, merely with a view of diverſifying the experiment, to apply a compound concave, formed of glaſs combined with the muriatic acid, which has been mentioned as a fluid poſſeſſing a conſiderable degree of diſperſive power. This opened a new and unexpected ſcene. The colours appeared in the ſame order as in the laſt experiment, but the fringes were ſo very broad as greatly to ſurpriſe me, and create a ſuſpicion that every thing was not as I had hitherto taken for granted. Without delay I included ſome of the marine acid between two convex lenſes, whoſe radii were duly proportioned to the diſperſive power of that fluid, for the purpoſe of correcting the colour. Upon applying an eye-glaſs I found my ſuſpicion verified. The fringes of green and purple appeared nearly of the uſual breadth, but in an inverted order, there being now a green fringe within the focus, and a purple fringe beyond it. I was the better pleaſed at being thus led to the

detection of this singular property of the acid of sea-salt, because, in making the same experiment before, this inversion of the order of the colours had entirely escaped me. I was then examining it, to find whether it dispersed the several orders of rays, in the same ratio in which glass does; and being satisfied that it did not, from observing the green and purple fringes, as in other combinations, a circumstance so little looked for, as the inversion of the order of the colours, did not strike me.

THIS observation affords a remarkable exception to what I had begun to consider as very probably a general law of nature. In the refraction which takes place in mediums of the least dispersive kind, the green rays, or rather perhaps the rays in the confine of green and blue, are the mean refrangible, and these same rays, in the more dispersive mediums, were always found among the less refrangible rays; and hence when, by a proper combination of two such mediums, the red and violet rays are united, these united red and violet rays constitute the least refrangible rays, and the green constitute the most refrangible rays, as before explained.

BUT in the muriatic acid, the case is just the reverse of this. Then the green rays, which in mediums that disperse the least, are the mean refrangible, and which in essential oils and metallic impregnations are found among the less refrangible, appear amongst the more refrangible. Whence in such a combination of the muriatic acid and an indispersive medium as shall unite the red and violet rays, these united red and violet rays emerge most refrangible, and the homogeneal green rays emerge least refrangible, being just the reverse of what takes place in combinations of crown-glass with flint-glass, or with essential oils, or saturated metallic solutions.

THIS unusual property of the marine acid does not, however, seem to admit of any immediate application to the improvement of optical instruments. It is true that, instead of having recourse to a compound concave for correcting the secondary

condary colour, this may be effected by a compound convex, which, inſtead of lengthening, will ſhorten the focal diſtance of the compound object-glaſs. But in a conſtruction of this kind, the correction of the ſpherical aberration would be attended with more difficulty.

Having thus found an exception to the general reſult of my former experiments, which was, that thoſe rays which in the leaſt diſperſive mediums conſtitute the mean refrangible rays, are in more diſperſive mediums found amongſt the leſs refrangible rays, it ſeemed not improbable that diſperſive mediums might exiſt, which would ſeparate the differently coloured rays exactly in the ſame proportion in which they are ſeparated by indiſperſive mediums.

I had now indeed got hold of a pretty ſure clue to lead me to mediums poſſeſſed of this property. It will appear from what has been ſaid concerning attraction, that when in a metallic ſolution or an eſſential oil, which ſeparate the red and violet rays in the ſame degree in which they are ſeparated by the marine acid, the green rays are found amongſt the leſs refrangible rays in the former fluids, and amongſt the more refrangible in the latter fluid, the cauſe of this difference muſt be, that the green light is more attracted by the marine acid than by eſſential oils or metallic ſolutions, when the attraction for the red and violet light is the ſame in all theſe mediums.

Hence it ſeemed reaſonable to conclude, that in a medium compounded in a due proportion of the particles compoſing theſe two kinds of diſperſive mediums, the attraction for the green rays would be in an intermediate degree, and might be rendered the ſame, in proportion to the attraction for the red and violet rays, which obtains in crown-glaſs and other indiſperſive mediums.

It might be found a matter of no ſmall difficulty to unite the eſſential oils with the marine acid, ſo as to form a colour-

leſs tranſparent fluid. But nothing can be better adapted for this purpoſe than metallic ſolutions.

I FIRST made trial of butter of antimony, and found the reſult to be what I expected. On increaſing the proportion of muriatic acid, the fringes of green and purple grew narrower and narrower till they entirely diſappeared, and if more was then added they re-appeared in an inverted order. I tried the ſame thing with a ſolution of crude ſal ammoniac and mercury ſublimate. If the ſolution contains a certain proportion of theſe two ſubſtances, the rays of all colours emerge from the compound object-glaſs equally refracted. If the proportion of the ammoniacal ſalt, and conſequently of the muriatic acid which it contains, be increaſed, the green rays, which were the mean refrangible in the diſperſive fluid, as well as in crown-glaſs, draw nearer to the violet, making a part of the more refrangible half of the ſpectrum, and conſequently emerge leſs refracted than the united red and violet rays, and are converged to a focus at a greater diſtance from the object-glaſs; ſo that the green fringe now appears within the focus, and the purple fringe beyond it. But on increaſing the proportion of mercurial particles, theſe ſame green rays ſhift their ſituation to the leſs refrangible half of the ſpectrum, which appears from their now emerging moſt refracted, and being converged to a point nearer to the object-glaſs than the united red and violet, whoſe refrangibility does not appear to be affected by theſe admixtures which occaſion ſuch remarkable fluctuations in the refrangibility of the green rays and other intermediate orders. It may poſſibly ſeem ſtrange at firſt view, that the green rays ſhould emerge moſt refracted from the compound object-glaſs, when their refrangibility in the diſperſive medium is diminiſhed, and leaſt refracted under the contrary circumſtances. The cauſe of this is, that the principal refraction of the compound object-glaſs is performed by the indiſperſive convex lens,

which

which is oppofite to the refraction produced by the difperfive concave.

It was formerly obferved, that in the confine of a rare difperfive medium, and a denfe indifperfive medium, there may be a fingle refraction, in which all the rays are equally refrangible; and it has fince been explained with what limitation this is to be underftood, in confequence of the unproportional difperfion which generally takes place in fuch mediums; of which I was then ignorant. The explanation which refers to the fecond, third, fourth and fifth diagrams, and to the object-glafs reprefented in the ninth figure, is to be confidered as ftrictly juft, when, in the fluid employed, the metallic particles are fo far diminifhed, and the particles of marine acid fo far increafed, as to render the refraction of the feveral orders of rays proportional in both mediums.

I HAVE got an object-glafs of this kind, which is reprefented in the twentieth figure. There are two refractions in the confine of glafs and the fluid, but not the leaft colour whatever. Hence it is manifeft that in the refraction which takes place in the confine of glafs and this fluid, and which, on account of the difference of their denfities, is very confiderable, there is no unequal refrangibility of light. The rays of different colours are bent from their rectilineal courfe with the fame equality and regularity as in reflection.

As cuftom has already appropriated the word *achromatic* to that kind of refraction in which there is only a partial correction of colour, in order to avoid confufion, I fhall beg permiffion to diftinguifh this entire removal of aberration by the term *aplanatic* *, till a better can be thought of.

BEFORE clofing this enquiry concerning the optical properties of tranfparent fubftances, I examined more minutely than I had done before, the qualities of the other mineral acids. The nitrous acid, when of the fame mean refractive denfity as the

* From the Greek α privative, and the verb Πλανάω.

the marine acid, does not difperfe the red and violet rays quite fo much. The green ray, as in the marine acid, is found among the more refrangible rays; but it approaches nearer to the place of the mean refrangible ray in the nitrous acid than in the marine. The green ray is alfo nearer to the place of the mean refrangible ray, than it is in effential oils or in faturated metallic folutions; and therefore the nitrous acid appears by thefe experiments to difperfe the feveral orders of rays more nearly in the fame proportion in which crown-glafs does, than any uncompounded difperfive medium, and would, I have no doubt, do fo exactly, if flightly impregnated with mercury, though this I have not tried.

The vitriolic acid is fcarcely to be claffed among difperfive mediums. The following experiment is the laft I made on the fubject. In a very good object-glafs, of that kind before defcribed, in which fpirit of wine is one of the mediums employed, I fubftituted fucceffively for this fpirit the vitriolic acid and a folution of fixed alkaline falt, both of them of nearly the fame mean refractive denfity as the fpirit of wine. Thefe three fluids, although they differ fo widely in their chemical properties, have their optical properties fo nearly alike, that I found it difficult to determine which was the medium employed. For when the fecondary colour is not corrected, as was the cafe in this object-glafs, the change of colour produced in the green and purple fringes to render it apparent, muft be confiderable, a flight fhade of difference not being eafily diftinguifhable. I therefore repeated the trial with an object-glafs, in which this green and purple light is totally removed; and then both the vitriolic acid, and the folution of fixed alkali, when of equal mean refractive denfity with fpirit of wine, appeared very fenfibly more difperfive than the fpirit. The difference in this refpect between the acid and the alkali was fcarcely to be diftinguifhed; and the effect of a folution of cauftic alkali appeared to be nearly the fame as that of mild

alkali

alkali of equal denſity. By ſimilar trials, the phoſphoric and acetous acids were found to be conſiderably more diſperſive than ſpirit of wine.

Although theſe experiments with compound object-glaſſes of very large apertures, afford both the readieſt and moſt accurate method of inveſtigating the optical properties of refracting mediums, it would be both amuſing and inſtructive to repeat them with compound priſms. I could have wiſhed in particular, had my preſent ſituation been convenient for the purpoſe, to have taken the dimenſions of the ſecondary ſpectrum, under given angles of incidence and refraction. For by comparing theſe with the dimenſions of the primary ſpectrum, accurately aſcertained by Sir Isaac Newton, the degree of ſuperiority of an object-glaſs compoſed of crown and flint glaſs, over a ſimple object-glaſs, and of one in which there is a regular refraction of all the rays, over both, might be aſcertained. At preſent, I can only ſtate the circumſtances of a compariſon I made between two compound object-glaſſes of equal apertures, but very unequal lengths. One was compoſed of crown-glaſs, ſpirit of wine and an eſſential oil. The focal length is about fourteen inches, and the aperture two inches. The other object-glaſs was of crown and flint-glaſs; its focal length thirty-two inches, and its aperture two inches. I had it for a good one of its kind, and upon examination found no particular defect in its ſtructure.

The ſhort teleſcope has a manifeſt advantage in the night, eſpecially in viewing fine objects, ſuch as double ſtars of inferior magnitudes, where the uncorrected colour is leſs hurtful.

But I was ſurpriſed, on viewing an object in bright ſunſhine, to find conſiderably more of that miſtineſs which ariſes from the unequal refrangibility of light, than appeared in the long teleſcope. I therefore diminiſhed the aperture of the ſhort one to one inch and a half, and comparing them again, there appeared no more of this miſt in the one than in the

other.

other. I farther reduced the aperture of the ſhort one to one inch, when it became manifeſtly clearer than the long one, though, upon examining the coloured fringes, by covering half the object-glaſs, they ſtill appeared of ſuch a breadth as muſt neceſſarily hurt the diſtinctneſs.

I HAVE here given the reſult of this experiment as I find it noted down. Being made with no view to the determination of the point in queſtion, the accuracy neceſſary for that purpoſe was not obſerved. It would appear, however, from this groſs and indirect trial, that the aberration from unequal refrangibility would not differ very materially in theſe object-glaſſes, ſuppoſing their apertures and focal diſtances to be equal; though in one the partial correction of colour is effected by a combination of flint-glaſs and crown-glaſs, and in the other by a combination of crown-glaſs and ſpirit of wine, with an eſſential oil. If this aberration were exactly equal in both combinations, the miſty indiſtinctneſs proceeding from it ought to be the ſame in both object-glaſſes, when the apertures and magnifying powers applied, are as the ſquare roots of their reſpective focal lengths.

IT would appear that the aperture of an object-glaſs, compoſed of crown and flint-glaſs of thirty-two inches in focal length, ought not to exceed two inches, and therefore that three inches is too large an aperture for one of forty-two inches focal length; for the lengths in theſe two caſes ought to be as four to nine. In ſome teleſcopes of this latter kind, I have obſerved a great deal of uncorrected colour, which prevents them from bearing magnifying powers, in proportion to the aperture of the object-glaſs. It is indeed but ſeldom that the union of the differently refrangible rays is ſo perfect as the conſtruction admits. I have met with others in which the real aperture is ſo far contracted, by diaphragms placed within the tube, as ſcarcely to exceed two inches.

FROM

FROM inſpecting the tables of the lengths and apertures of teleſcopes with ſimple object-glaſſes, it will appear, that the required length for an aperture of two inches is about thirteen feet. This exceeds two feet and an half, the length given to an achromatic teleſcope, whoſe object-glaſs is two inches in diameter, between five and ſix times. The length of the ſtandard Hugenian teleſcope, whoſe aperture is three inches, is thirty feet. This is between eight and nine times the length of an achromatic teleſcope, the aperture of which is likewiſe three inches, and its length three and a half feet. But if the aberration from unequal refrangibility be diminiſhed to the ſame degree as in the thirty inch teleſcope, the length muſt be increaſed, from three and a half feet to about five and a half. For its length muſt be to thirty inches, the length of the two inch aperture, as the ſquare of two to the ſquare of three, and then the teleſcope with the ſimple object-glaſs will only exceed it in length between five and ſix times as before.

THE obſervations which have been mentioned put it beyond a doubt, that the limit to the apertures and magnifying powers of what have been improperly called achromatic teleſcopes, is the very ſame which limits the performance of teleſcopes with ſimple object-glaſſes, namely, the unequal refrangibility of light; and it would ſeem, that the aberration from this cauſe may be diminiſhed, by a combination of lenſes of crown and flint glaſs, between five and ſix times.

Sir ISAAC NEWTON, by accurate experiments, hath determined the diameter of the leaſt circular ſpace within which parallel rays of all kinds can be collected by a ſimple lens, to be one fifty-fifth part of the diameter of the aperture of the lens. If the aberration, from unequal refrangibility in a compound object-glaſs, vitiates the diſtinctneſs leſs than in a ſimple object-glaſs, in the proportion of one to ſix, it may ſeem a reaſonable concluſion, that the leaſt circular ſpace within which parallel rays of all kinds can be gathered by an object-glaſs compoſed

 of

of crown and flint glafs, ought to be one fixth of one fifty fifth part of its aperture. The difference in the focal lengths of the eye-glaffes will then render the indiftinctnefs nearly equal in the two kinds of object-glaffes with equal magnifying powers, in all cafes where their apertures are equal, and their lengths as one to fix.

There is, however, a circumftance of the greateft moment to be taken into account before this conclufion can be admitted, which is, that not merely the diameter of the circle of aberration is to be confidered, but alfo the fpiffitude of the rays, both within that circle in general, and at different diftances from its centre. The rarity of the light in the fimple fpectrum is fuch, that the aberration hurts much lefs than might be expected. But in the fecondary fpectrum, as two orders of coloured light are united, the imperfect union of the rays by the compound object-glafs, will hurt the diftinctnefs much more, in proportion to the extreme divergency.

On this account, it is to be expected, that the proportional lengths of the fpectrums, when the experiment comes to be properly made, will turn out lefs than as one to fix, notwithftanding the degree in which the diftinctnefs is hurt in the two kinds of telefcopes, from the unequal refrangibility of light, may be nearly in that proportion.

The principal improvement of refracting telefcopes, pointed out by the preceding experiments, confifts in an entire removal of this aberration from the unequal refrangibility of light. It appears from the performance of the fmall telefcope above mentioned, in which the fecondary colour is not removed, that confiderable advantages may alfo be expected from fubftituting a more perfect medium for flint-glafs; from a more perfect correction of the aberration from the fpherical figure; from preventing that lofs of light by reflection, which takes place when light enters into, or emerges from denfe mediums furrounded

with

with air; and from diminiſhing thoſe errors which ariſe from faults in the workmanſhip.

The diſadvantages under which reflecting teleſcopes labour, ariſe from their requiring larger apertures to tranſmit the ſame quantity of light; from being found to be more affected by imperfections of the atmoſphere than refracting teleſcopes, and being liable to tarniſh; but principally from imperfections in the workmanſhip of the object ſpeculum hurting their performance much more than equal imperfections in the object-glaſs hurt refractors.

The deviation of a ray from its intended courſe, occaſioned by an imperfection in the figure of a reflecting ſpeculum, is to its deviation, ariſing from an equal imperfection in a lens, as four to one, when the ray paſſes from glaſs into air, and in the proportion of ſix to one, when it paſſes from air into glaſs. At a medium, therefore, it may be ſtated as five to one. It follows from hence, that ſuppoſing all other cauſes of imperfection removed but this of workmanſhip, and that the metal of ſpeculums were capable of as good a poliſh as glaſs, and of reflecting as much light as glaſs tranſmits, ſtill the perfection of the images of objects formed by refraction would greatly exceed thoſe by reflection.

Such is the caſe in the refractions which take place in the confine of glaſs and air. But in the refractions made in the confine of glaſs, and mediums of greater denſity than air, the difference is ſtill much greater.

The proportion of the ſine of the angle of incidence to the ſine of the angle of refraction of a ray in paſſing out of one medium into another medium, is compoſed of the proportion of the ſine of the angle of incidence to the ſine of the angle of refraction out of the firſt medium into any third medium, and of the proportion of the ſine of the angle of incidence to the ſine of the angle of refraction, out of that third medium into the ſecond medium.

Thus, if the ſine of the angle of incidence of any ray, in paſſing out of glaſs into air, be to the ſine of its angle of refraction as twenty to thirty-one, and the ſine of the angle of incidence of the ſame ray, in paſſing from air into oil of turpentine, be to the ſine of its angle of refraction as twenty-five to ſeventeen, the proportion of the ſine of the angle of incidence of that ray, to the ſine of its angle of refraction, in paſſing out of glaſs into oil of turpentine, will be as five hundred to five hundred and twenty-ſeven.

Hence the point to which light is converged by the refraction of a ſpherical ſegment of glaſs, ſurrounded with oil of turpentine, will be found to be above eighteen ſemi-diameters of the ſphere from the apex of the lens, when light paſſes from oil of turpentine into glaſs, and ſeventeen ſemi-diameters of the ſphere diſtant from the ſpherical ſegment, when light paſſes from glaſs into oil of turpentine; whereas in glaſs ſurrounded by air, the focal diſtance in theſe two caſes is only two ſemi-diameters, and three ſemi-diameters; and when light is converged to a point by a concave reflecting ſpeculum, the focal diſtance is only half a ſemi-diameter of the ſphere to which the ſpeculum is ground concave. Now, in all theſe caſes, the errors of the rays ariſing from imperfections in the workmanſhip of object-glaſſes, or object-ſpeculums, are as the focal diſtances to the radii of convexity; ſo that what Sir Isaac Newton mentions, of his having nearly deſpaired of reflecting teleſcopes from this conſideration, need not be wondered at.

The great pains, however, which he took with his own hands, and the ingenious methods which he ſuggeſted, and which have been ſo ably proſecuted ſince his time, have gone farther than could be expected towards obviating this fundamental fault of reflectors. Whatever can be performed by reflection, may be expected from the long experience and indefatigable exertions of Dr Herschel, aided by the countenance

nance and liberal ſupport of the Royal Founder of our Society, the general Patron of Science.

I APPREHEND there is a cauſe which will render ſhort teleſcopes always more diſtinct than long ones, where all other circumſtances are, as nearly as poſſible, alike; and that it has operated in favour of reflecting teleſcopes. It is well known that groſs bodies act on light at a diſtance. Some phenomena I have obſerved, appear to me to put it beyond doubt, that light alſo acts upon light, in ſuch a way as to propagate this action of groſs bodies much farther than is imagined. But I muſt delay entering farther on this ſubject; and ſhall only obſerve, that it was principally with an eye to this circumſtance, that I endeavoured in my attempts to execute object-glaſſes on the above principles, to ſtrain the increaſe of aperture to the utmoſt.

IT will be underſtood, that when the aberrations from the difference of refrangibility of light, and from the ſpherical figures of lenſes are removed, there remains no farther limit to ſhortening teleſcopes, excepting from the requiſite depth of the ſpheres and thickneſs of the glaſſes.

I FIND that in ſmall object-glaſſes of about nine inches focal length, the aperture may be increaſed as far as three inches, and hardly beyond this, on account of the quick increaſe of depth of the ſpherical ſurfaces, and thickneſs of the glaſs. From the difficulty found in procuring good glaſs of ſufficient thickneſs, it may perhaps be better to make the aperture for common purpoſes leſs than this. I ſhall therefore ſtate it at two inches. Hence the lengths neceſſary for increaſed apertures may readily be found, as the increaſe of length is in the ſame ratio as the increaſe of aperture, a double aperture requiring a double length, and ſo forth. Theſe lengths and apertures may be compared with the lengths and apertures neceſſary in ſingle lenſes, and in different kinds of reflectors, by the common tables.

IT

It appears from the preceding experiments, that in compound object-glaſſes of crown and flint-glaſs, there is only a partial correction of the aberration from unequal refrangibility, and therefore in them, and others of that kind, the apertures and magnifying powers muſt only be increaſed in a ſubduplicate ratio of the increaſe of length, as in ſingle lenſes.

I will not pretend to ſtate with abſolute certainty the preciſe aperture which an achromatic teleſcope of a given length ought to have. This muſt be determined by experience. If two inches be taken for the greateſt aperture which ought to be given to a teleſcope of this kind two and thirty inches long, then three inches will be too much for one of forty-two inches, as hath been already obſerved. But whichſoever of theſe lengths and apertures be taken as the ſtandard, it is certain, that if we would avoid a greater degree of that indiſtinctneſs which is occaſioned by the aberration from difference of refrangibility, the aperture and magnifying power muſt not be increaſed in a greater proportion than the ſquare root of the increaſed length. Beſides, therefore, that this imperfect correction renders ſuch teleſcopes incapable of bearing high magnifying powers for thoſe of moderate lengths, large inſtruments, if they were to be attempted, would ſtill be unmanageable, on account of their immoderate lengths. The focal length of an object-glaſs of this kind, four feet in diameter, would require to be upwards of fifteen hundred feet, in order to enable it to bear the magnifying power adapted to that aperture, with the ſame diſtinctneſs that is found in an object-glaſs two inches in diameter, and thirty-two inches in focal length. But when the aberration from difference of refrangibility is totally removed, the focal length of an object-glaſs four feet in diameter, need not exceed twenty feet.

Having mentioned to ſome friends the imperfect correction of the aberration from difference of refrangibility, which is obtained by the common combination of two mediums which differ

differ in dispersive power, I was informed, that something of the same kind had been observed by some foreign philosophers, and in particular by the celebrated M. CLAIRAUT and M. BOSCOVICH.

THE observation of the former appears in a Memoir of the French Academy of Sciences, of so old a date as the year 1757. As the passage relating to this subject is short, and does great credit to the author, as an accurate observer of the results of experiments, I shall beg permission to transcribe it. "Il y a en-"core un fait important que nos experiences nous ont appris, "c'est que les corrections des iris faites par les prismes combi-"nés, ne sont jamais aussi parfaites qu'on le croiroit d'après "les termes de M. DOLLOND. Dans le cas du prisme de verre "placé dans l'eau; par example, après avoir fait varier les "plaques qui determinent l'angle du prisme d'eau, jusqu'au "point où les objects vûs à travers les deux prismes, ne parois-"sent point décolorés, du moins aux vûes ordinaires, on trouve "en plaçant ces prismes dans la chambre noire, qu'il reste toû-"jours quelque petit limbe de couleur vers les bordes de "l'image du soleil, ce qui vient sans doute de ce que les par-"ties du spectre que chaque matiere réfringente donne, ne sont "pas exactement proportionelles aux longueurs totales de ces "spectres. Mais ces inégalités qui deminuent à mesure que "les angles des prismes sont plus petits, doivent étre comme "insensibles dans le cas des lentilles adossées, vû la petitesse des "angles de refringence qui ont lieu alors." I shall only remark on this passage, that M. CLAIRAUT would have observed the uncorrected colour better, if he had made use of a much smaller pencil of light than he appears to have done, and would not have concluded so hastily, that this uncorrected aberration was of little consequence to the performance of telescopes, if he had recollected, that the smallness of the angles of the lenses is greatly overbalanced by the magnifying power of the eye-glass.

M.

M. Boscovich formed an hypothefis concerning a perfect correction of colour, by a combination of mediums, which appears to have greatly mifled him. As a combination of two mediums is neceffary to unite two of the unequally refrangible rays, he imagines three mediums neceffary to unite three, four to unite four, and, in fhort, that to effect a perfect union of the rays of the fpectrum, as many mediums are required as there are unequally refrangible rays compofing it, that is to fay, an indefinite number. He fuppofes, however, than an union of three of the rays only, by means of three mediums, would greatly improve telefcopes. This author feems to have founded his hypothefis on the fame kind of loofe analogical reafoning, which had before led the celebrated Euler into a fimilar miftake.

The eye is compofed of three humours and feveral coats; and M. Boscovich takes it for granted, that a more perfect union of the rays than what takes place in a combination of crown and flint glafs, is effected by their means. But this is a fuppofition very remote from the truth indeed. So far is this fecondary colour from being corrected in the human eye, that in the conftruction of this admirable organ, it hath been deemed unneceffary to introduce any contrivance for the correction of the Newtonian aberration. *Natura nihil agit fruftra.* The perfection of the Contriver equally appears from a manifeftation of his power, and of his œconomical exertion of that power. On account of the fhortnefs of the focal diftance of the humours of the eye, in proportion to the aperture of the pupil, the aberration from the fpherical figure would be enormous; and we find it obviated by the very elaborate artifice of rendering the chryftalline humour more denfe towards the centre. The aberration from difference of refrangibility might have been removed, by imparting a proper degree of difperfive power to the vitreous humour. But this, being unneceffary for the common purpofes of life, is withheld.

Dr

Dr Maskelyne has taken the pains to compute the quantity of this aberration in the eye, and is of opinion that it is not incompatible with diſtinct viſion *. But as it has been juſt aſſerted as a matter of fact, that the aberration from difference of refrangibility is not corrected in the human eye, it will be expected that the proofs on which this aſſertion is founded, ſhould be explained. Theſe are ſo ample as to leave no cauſe of uncertainty; nor are the neceſſary experiments attended with much trouble. For it happens that the humours are better placed for the purpoſe in the natural eye, than art could diſpoſe them elſewhere.

When I take the penknife which now lies before me, and hold it between me and the ſky, at the diſtance to which the eye is conformed for diſtinct viſion, the blade appears diſtinct, and well defined. If the eye be now accommodated to a more diſtant object, the blade of the knife begins to be ſurrounded with a penumbra; and if this penumbra be carefully attended to, it appears to be coloured, and the colour next to the knife is red inclining to orange, which is the colour of the leaſt refrangible rays.

If the eye be again accommodated to the diſtance neceſſary for ſeeing the knife diſtinctly, the bars of the window, which is at a greater diſtance than the knife, are ſurrounded with a penumbra, and the colour of this penumbra is blue, which is the prevailing colour of the moſt refrangible rays. The ſame appearances will be obſerved in all caſes where the confine of a dark and luminous object is carefully examined, and will be ſo much the more conſpicuous by how much the contraſt of light and darkneſs is ſtronger. It requires, however, a capacity of viewing with attention an object to which the eye is not conformed, which muſt be acquired by habit. The following eaſy experiment may be tried by any one. Shutting one eye, obſerve with the other the four well defined black pa-

* Philoſophical Tranſactions of London, Vol. lxxix. p. 256.

rallel lines which denote four o'clock in the enamelled dial-plate of a watch, and make the watch approach the eye very ſlowly. So long as the eye can conform itſelf to the diſtance, the black lines will appear diſtinct and of their proper colours. But when the watch, continuing to approach, is brought too near for the eye, by any effort, to ſee the lines diſtinctly, the coloured fringes will begin to make their appearance, and the ſpreading of the leſs refrangible rays into the black ſtrokes, and the more refrangible rays into the white intervals, will make them appear to change their colours from black and white to orange and blue.

If any doubt ſhould remain concerning the priſmatic colour produced by the refraction of the humours of the eye, let the obſerver look at a bar of the window, where it is oppoſed to the ſky, and holding his hand parallel with the bar, bring it ſlowly over his eye, he will obſerve, juſt before the bar diſappears, one ſide of it edged with red inclining to orange, and the other with blue, and theſe colours in as great quantity as would be produced by a priſm of a pretty conſiderable refracting angle. The application of theſe obſervations to what was before ſaid of the fringes of colour produced by ſimple and compound lenſes, is obvious. If the aberration from difference of refrangibility were perfectly corrected, no colour whatever would appear, either in the penumbras, or on covering part of the pupil. Had this been effected, it is probable that the vitreous humour would be found ſufficiently diſperſive to correct the colour produced by the aqueous and cryſtalline humours, and that the ratio in which it ſeparated the rays which form the coloured ſpectrum, would be the ſame as in them. Such a colourleſs refraction might then be produced as has been found to ariſe from a combination of crown-glaſs with a fluid medium, containing a due proportion of metallic particles and particles of marine acid.

If

If the coloured penumbras, inſtead of being red when the eye is conformed to a greater diſtance than that of the object obſerved, and blue when conformed to a leſs diſtance, had been purple in the former caſe, and green in the latter, it would be reaſonable to conclude, that the vitreous humour was a diſperſive medium of the ſame kind with eſſential oils, and ſuch as owe this property to metalline particles with which they are impregnated.

But if the purple fringe had appeared round the object, when the eye is conformed to too ſmall a diſtance for ſeeing it diſtinctly, and with a green fringe under the contrary circumſtances, this would indicate a diſperſive power in the vitreous humour, ſimilar to that of the muriatic acid.

In ſome animals, and particularly in birds of prey, the images of objects on the retina are required to be more perfect than in the human eye. It would be an object of ſome moment in comparative phyſiology, to determine whether there be any partial or total correction of aberration from the difference of refrangibility in the eyes of theſe animals, which, if found neceſſary, will without doubt be the caſe. In ſome experiments which I once attempted with the vitreous humour, I found irregularities ariſe in the refraction, from giving it a figure different from its natural one. Poſſibly ſuch difficulties might be obviated by diluting the humours with ſome mild fluid of known optical properties.

The aberration from unequal refrangibility not being corrected in the eye, is one cauſe why viſion through a good teleſcope is more perfect, independent of magnifying power, than naked viſion when moſt perfect; a fact which muſt appear ſo extraordinary, that it can ſcarcely be expected to be credited, except by thoſe who have convinced themſelves of it by experience.

In order to explain this, it muſt be obſerved, that the ultimate effect required to be produced by a teleſcope or microſcope,

is not a perfect union of the rays at the focus of the object-glaſs, but at the retina. This is to be effected by ſo diſpoſing the rays at their emergence from the eye-glaſs, that the humours of the eye ſhall accurately converge each of the pencils to one point of the retina. If we conceive a point of the retina to become a radiant point whence the rays iſſue, the rays of different colours, at their emergence from the cornea, will be inclined to each other in a certain degree, on account of their unequal refrangibility, and will continue to diverge, till they arrive, we ſhall ſuppoſe, at the eye-glaſs. Now, this is exactly the ſtate in which rays emerging from the eye-glaſs, and tending towards the eye, ought to be, in order to inſure their perfect union at that point of the retina from which the above mentioned rays were ſuppoſed to radiate.

ANOTHER cauſe which operates in favour of teleſcopic viſion, is the ſmallneſs of the pencil where it enters the eye. When the diameter of the pencil is equal to that of the pupil, the rays, in paſſing the edge of the iris, are inflected, that is to ſay, they are made to deviate from their rectilineal courſe, ſome of them being bent towards the iris, and others from it, and thus throw a ſcattered light round the image on the retina. The radiation of the bright fixed ſtars proceeds partly from this cauſe. This ſource of indiſtinctneſs is totally removed in a teleſcope, where the diameter of the pencil, at its entrance into the eye, is ſo much leſs than the pupil, that none of the rays paſs near enough the iris to ſuffer any inflection. The ſize of the pencil muſt not, however, be diminiſhed too far; for if this is done beyond a certain degree, the diſtinctneſs will be quite deſtroyed, as was firſt obſerved by HUGENIUS.

I SHALL now recapitulate, and preſent in one view, the contents and ſcope of this diſcourſe.

THE unequal refrangibility of light, as diſcovered and fully explained by Sir ISAAC NEWTON, ſo far ſtands its ground uncontroverted,

controverted, that when the refraction is made in the confine of any medium whatever, and a vacuum, the rays of different colours are unequally refracted, the red-making rays being the least refrangible, and the violet-making rays the most refrangible.

The discovery of what has been called a different dispersive power in different refractive mediums, proves those theorems of Sir Isaac Newton not to be universal, in which he concludes that the difference of refraction of the most and least refrangible rays, is always in a given proportion to the refraction of the mean refrangible ray. There can be no doubt that this position is true with respect to the mediums on which he made his experiments; but there are many exceptions to it.

For the experiments of Mr Dollond prove, that the difference of refraction between the red and violet rays, in proportion to the refraction of the whole pencil, is greater in some kinds of glass than in water, and greater in flint-glass than in crown-glass.

The first set of experiments above recited, prove, that the quality of dispersing the rays in a greater degree than crown-glass, is not confined to a few mediums, but is possessed by a great variety of fluids, and by some of these in a most extraordinary degree. Solutions of metals, essential oils, and mineral acids, with the exception of the vitriolic, are most remarkable in this respect.

Some consequences of the combinations of mediums of different dispersive powers, which have not been sufficiently attended to, are then explained. Although the greater refrangibility of the violet rays than of the red rays, when light passes from any medium whatever into a vacuum, may be considered as a law of nature; yet in the passage of light from one medium into another, it depends entirely on the qualities of the mediums, which of these rays shall be the most refrangible, or whether there shall be any difference in their refrangibility.

The

The application of the demonſtrations of Hugenius to the correction of the aberration from the ſpherical figures of lenſes, whether ſolid or fluid, is then taken notice of, as being the next ſtep towards perfecting the theory of teleſcopes.

Next it appears from trials made with object-glaſſes of very large apertures, in which both aberrations are corrected as far as the principles will admit, that the correction of colour which is obtained by the common combination of two mediums which differ in diſperſive power, is not complete. The homogeneal green rays emerge moſt refracted, next to theſe the united blue and yellow, then the indigo and orange united, and laſtly the united violet and red, which are leaſt refracted.

If this production of colour were conſtant, and the length of the ſecondary ſpectrum were the ſame in all combinations of mediums when the whole refraction of the pencil is equal, the perfect correction of the aberration from difference of refrangibility would be impoſſible, and would remain an inſurmountable obſtacle to the improvement of dioptrical inſtruments.

The object of the next experiments is, therefore, to ſearch, whether nature affords mediums which differ in the degree in which they diſperſe the rays compoſing the priſmatic ſpectrum, and at the ſame time ſeparate the ſeveral orders of rays in the ſame proportion. For if ſuch could be found, the above mentioned ſecondary ſpectrum would vaniſh, and the aberration from difference of refrangibility might be removed. The reſult of this inveſtigation was unſucceſsful with reſpect to its principal object. In every combination that was tried, the ſame kind of uncorrected colour was obſerved, and it was thence concluded, that there was no direct method of removing the aberration.

But it appeared in the courſe of the experiments, that the breadth of the ſecondary ſpectrum was leſs in ſome combinations than in others, and thence an indirect way opened, leading to the correction ſought after; namely, by forming a compound

pound concave lens of the materials which produce moſt colour, and combining it with a compound convex lens formed of the materials which produce leaſt colour; and it was obſerved in what manner this might be effected by means of three mediums, though apparently four are required.

In ſearching for mediums beſt adapted for the above purpoſe, a very ſingular and important quality was detected in the muriatic acid. In all the diſperſive mediums hitherto examined, the green rays, which are the mean refrangible in crown-glaſs, were found among the leſs refrangible, and thence occaſion the uncorrected colour which has been deſcribed. In the muriatic acid, on the contrary, theſe ſame rays make a part of the more refrangible; and in conſequence of this, the order of the colours in the ſecondary ſpectrum, formed by a combination of crown-glaſs with this fluid, is inverted, the homogeneal green being now the leaſt refrangible, and the united red and violet the moſt refrangible.

This remarkable quality found in the marine acid led to complete ſucceſs in removing the great defect of optical inſtruments, that diſſipation or aberration of the rays, ariſing from their unequal refrangibility, which has rendered it impoſſible hitherto to converge all of them to one point, either by ſingle or oppoſite refractions. A fluid in which the particles of marine acid and metalline particles hold a due proportion, at the ſame time that it ſeparates the extreme rays of the ſpectrum much more than crown-glaſs, refracts all the orders of rays exactly in the ſame proportion as the glaſs does; and hence rays of all colours, made to diverge by the refraction of the glaſs, may either be rendered parallel by a ſubſequent refraction made in the confine of the glaſs and this fluid, or by weakening the refractive denſity of the fluid, the refraction which takes place in the confine of it and glaſs, may be rendered as regular as reflection, while the errors ariſing from unavoidable imperfections of workmanſhip, are far leſs hurtful than in reflection,

and

and the quantity of light tranſmitted by equal apertures of the teleſcopes much greater.

SUCH are the advantages which the theory preſents. In reducing this theory to practice, difficulties muſt be expected in the firſt attempts. Many of theſe it was neceſſary to ſurmount before the experiments could be completed. For the delicacy of the obſervations is ſuch, as to require a conſiderable degree of perfection in the execution of the object-glaſſes, in order to admit of the phenomena being rendered more apparent by means of high magnifying powers. Great pains ſeem to have been taken by mathematicians to little purpoſe in calculating the radii of the ſpheres requiſite for achromatic teleſcopes, from their not conſidering that the object-glaſs itſelf is a much nicer teſt of the optical properties of refracting mediums than the groſs experiments made by priſms, and that the reſults of their demonſtrations cannot exceed the accuracy of the data, however much they may fall ſhort of it.

I SHALL conclude this paper, which has now greatly exceeded its intended bounds, by enumerating the ſeveral caſes of unequal refrangibility of light, that their varieties may at once be clearly apprehended.

IN the refraction which takes place in the confine of every known medium and a vacuum, rays of different colours are unequally refrangible, and the red-making rays are leaſt refrangible, and the violet-making rays are moſt refrangible.

THIS difference of refrangibility of the red and violet rays is not the ſame in all mediums. Thoſe mediums in which the difference is greateſt, and which, by conſequence, ſeparate or diſperſe the rays of different colours moſt, have been diſtinguiſhed by the term *diſperſive*, and thoſe mediums which ſeparate the rays leaſt have been called *indiſperſive*. Diſperſive mediums differ from indiſperſive, and ſtill more from each other, in another very eſſential circumſtance.

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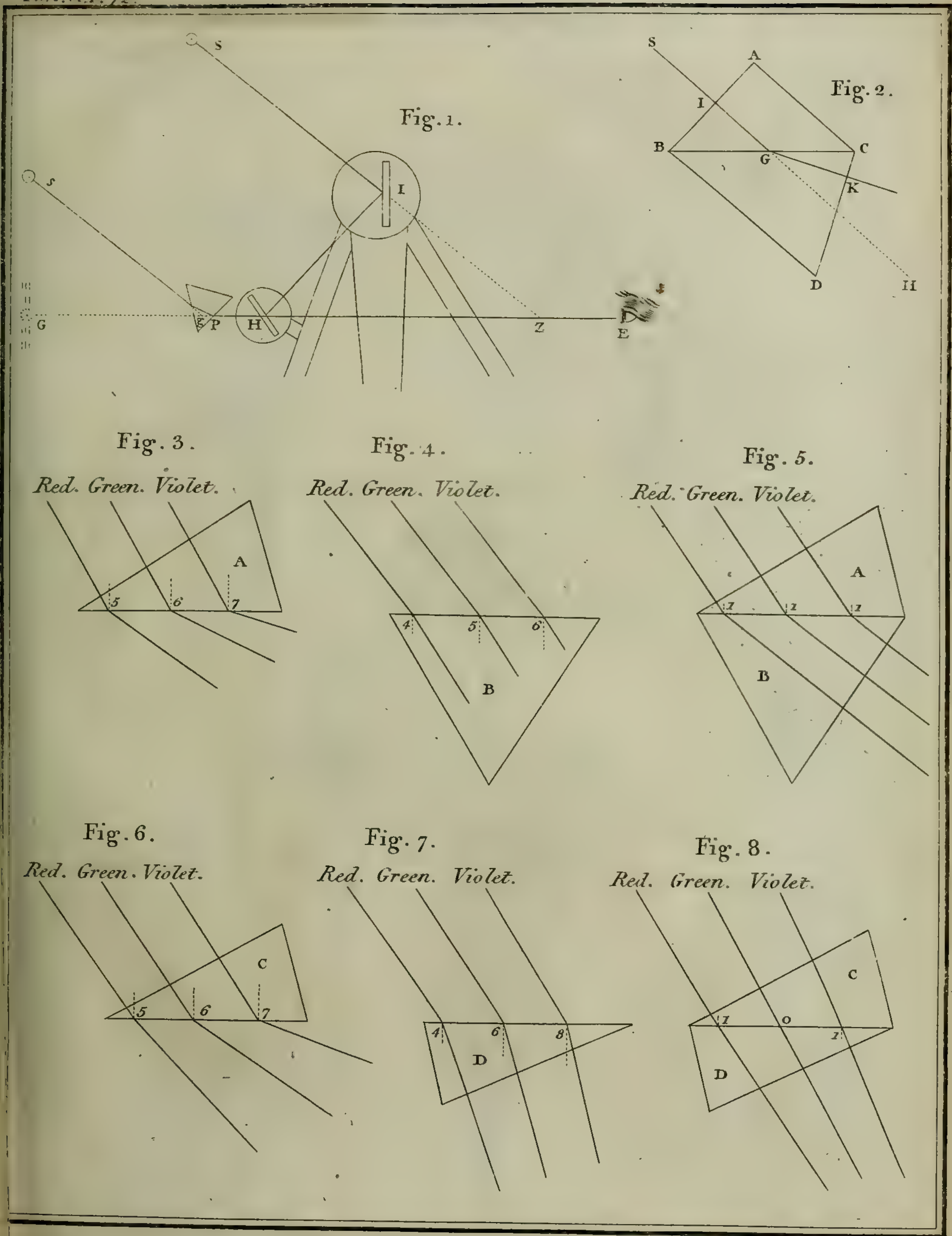


Jn.o Lodge sculp

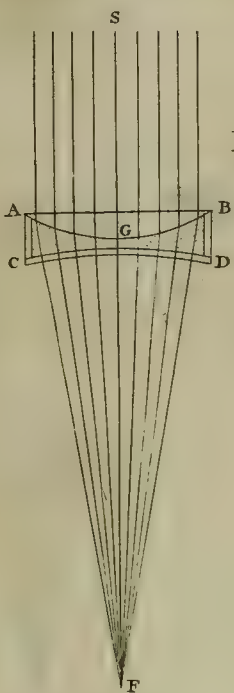


Fig. 9.

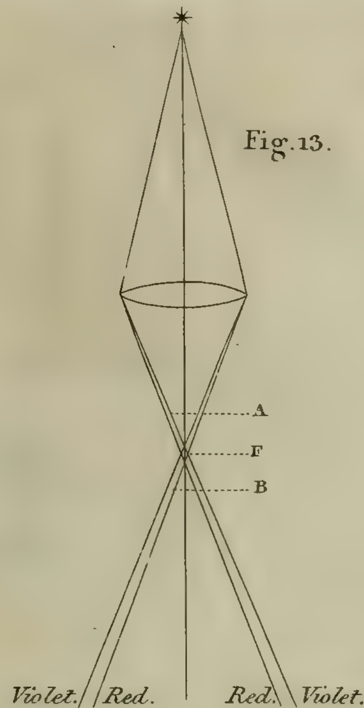
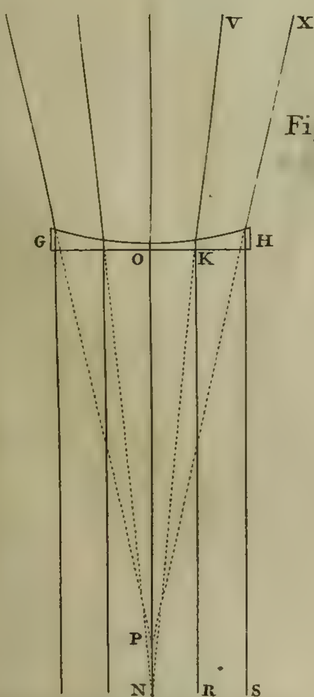


Fig. 13.



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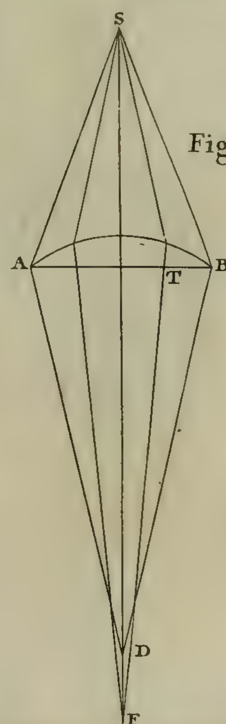

Fig. 10.

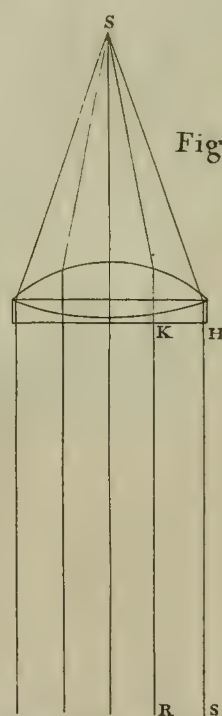

Fig. 12.

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Fig. 20.

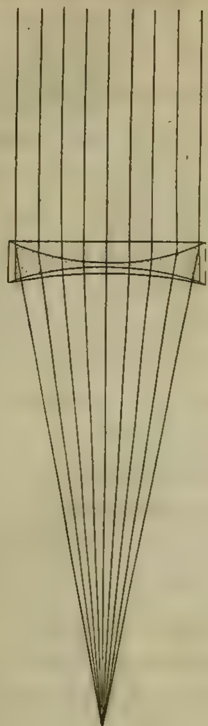


Fig. 14.

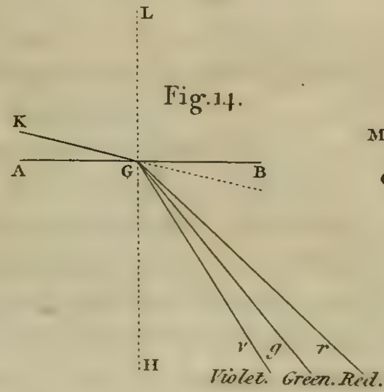


Fig. 15.

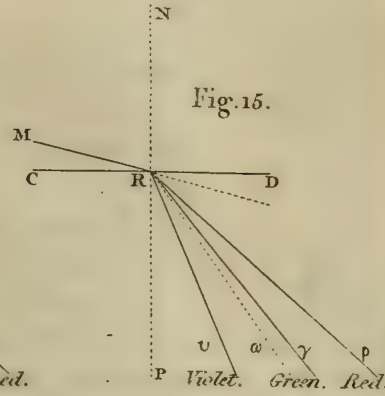


Fig. 16.

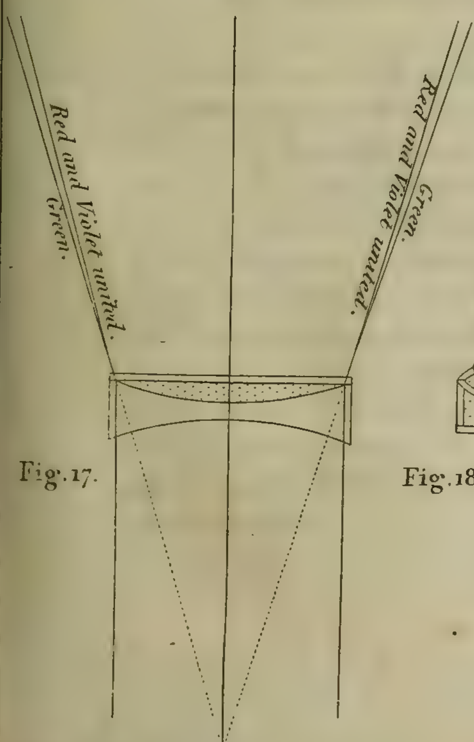
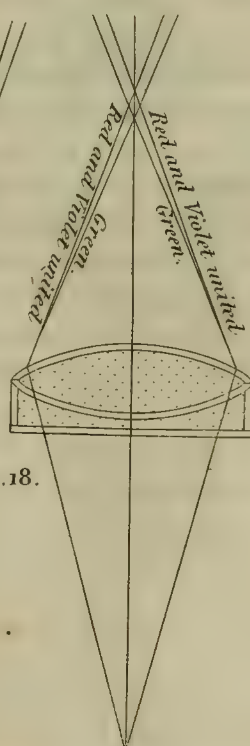


Fig. 17.



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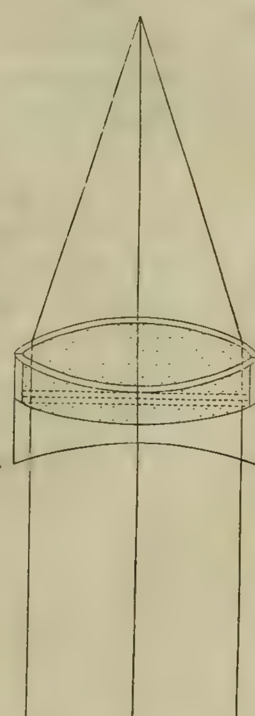

Fig. 19.

Jn.o Lodge sculp.

It appears from the experiments which have been made on indifperfive mediums, that the mean refrangible light is always the fame, and of a green colour.

Now, in by far the largeft clafs of difperfive mediums, including flint-glafs, metallic folutions, effential oils, the green light is not the mean refrangible order, but forms one of the lefs refrangible orders of light, being found in the prifmatic fpectrum nearer to the deep red than the extreme violet.

In another clafs of difperfive mediums, which includes the muriatic and nitrous acids, this fame green light becomes one of the more refrangible orders, being now found nearer to the extreme violet than the deep red.

These are the varieties in the refrangibility of light, when the refraction takes place in the confine of a vacuum; and the phenomena will fcarce differ fenfibly in refractions made in the confine of denfe mediums and air.

But when light paffes from one denfe medium into another, the cafes of unequal refrangibility are more complicated.

In refractions made in the confine of mediums which differ only in ftrength, not in quality, as in the confine of water and crown-glafs, or in the confine of the different kinds of difperfive fluids more or lefs diluted, the difference of refrangibility will be the fame as above ftated in the confine of denfe mediums and air, only the whole refraction will be lefs.

In the confine of an indifperfive medium, and a rarer medium belonging to either clafs of the difperfive, the red and violet rays may be rendered equally refrangible. If the difperfive power of the rare medium be then increafed, the violet rays will become the leaft refrangible, and the red rays the moft refrangible. If the mean refractive denfity of the two mediums be rendered equal, the red and violet rays will be refracted in oppofite directions, the one towards, the other from the perpendicular.

Thus it happens to the red and violet rays, whichſoever claſs of diſperſive mediums be employed. But the refrangibility of the intermediate orders of rays, and eſpecially of the green rays, will be different when the claſs of diſperſive mediums is changed.

Thus in the firſt caſe, where the red and violet rays are rendered equally refrangible, the green rays will emerge moſt refrangible, if the firſt claſs of diſperſive mediums is uſed, and leaſt refrangible if the ſecond claſs is uſed. And in the other two caſes, where the violet become leaſt refrangible, and the red moſt refrangible, and where theſe two kinds of rays are refracted in oppoſite directions, the green rays will join the red, if the firſt claſs of diſperſive mediums be employed, and will arrange themſelves with the violet, if the ſecond claſs be made uſe of.

Only one caſe more of unequal refrangibility remains to be ſtated; and that is, when light is refracted in the confine of mediums belonging to the two different claſſes of diſperſive fluids. In its tranſition, for example, from an eſſential oil, or a metallic ſolution, into the muriatic acid, the refractive denſity of theſe fluids may be ſo adjuſted, that the red and violet rays ſhall ſuffer no refraction in paſſing from the one into the other, how oblique ſoever their incidence be. But the green rays will then ſuffer a conſiderable refraction, and this refraction will be from the perpendicular, when light paſſes from the muriatic acid into the eſſential oil, and towards the perpendicular, when it paſſes from the eſſential oil into the muriatic acid. The other orders of rays will ſuffer ſimilar refractions, which will be greateſt in thoſe adjoining the green, and will diminiſh as they approach the deep red on the one hand, and the extreme violet on the other, where the refraction ceaſes entirely.

The manner of the production of theſe effects, by the attraction of the ſeveral mediums, may be thus explained.

We

We ſhall ſuppoſe the attractive forces, which produce the refractions of the red, green and violet light, to be repreſented by the numbers eight, twelve and ſixteen, in glaſs; ſix, nine, fourteen, in the metallic ſolution; ſix, eleven, fourteen, in the muriatic acid; and ſix, ten, fourteen, in a mixture of theſe two fluids. The exceſs of attraction of glaſs for the red and violet light is equal to two, whichſoever of the three fluids be employed. The refraction oftheſe two orders of rays will therefore be the ſame in all the three caſes. But the exceſs of attraction for the green light is equal to three, when the metallic ſolution is uſed, and therefore the green light will be more refracted than the red and violet, in this caſe. When the muriatic acid is uſed, the exceſs of attraction of glaſs for the green light is only one, and therefore the green light will now be leſs refracted than the red and violet. We ſhall next ſuppoſe the metallic ſolution and the acid to adjoin each other. The attractions of both theſe mediums, for the red light being ſix, and for the violet light fourteen, theſe two orders of rays will ſuffer no refraction in the confine of the two fluids, the difference of their attractions being equal to nothing.

But the attractive force of the metallic ſolution for the green ray being only nine, and that of the muriatic acid for the ſame ray being eleven, the green light will be attracted towards the muriatic acid with the force two; and therefore the difference between the refraction of the green light and the unrefracted red and violet light which takes place in the confine of theſe fluids, will greatly exceed the difference of refraction of the green light, and equally refracted red and violet light, which is produced in the confine of glaſs and either of the fluids.

Lastly, in a mixture of the two kinds of fluids, the attraction for the red, green and violet rays, being ſix, ten and fourteen, and that of the glaſs, eight, twelve and ſixteen, the exceſs of the attraction of the glaſs for the green rays, is the ſame

which it is for the red and violet rays. Thefe three orders of rays will therefore fuffer an equal refraction, being each of them attracted towards the glafs with the force two; and when this is the cafe, it appears from the obfervations, that the indefinite variety of rays of intermediate colours and fhades of colours, which altogether compofe folar light, will alfo be regularly bent from their rectilinear courfe, conftituting what has been termed *aplanatic refraction.*

THESE cafes of attraction might be farther illuftrated by means of diagrams. But after the explanation already given of the fecond, third, fourth, fifth, fixth, feventh and eighth figures, this would be unneceffary. And it need fcarcely here be obferved, that the above rough ftatements in round numbers, are intended to give a clear idea of the nature of the various cafes of unequal refrangibility, and not to afcertain its quantity in any particular cafe. A full inveftigation of the fubject, and an account of fome digreffions lefs immediately connected with the principal object which occurred in the courfe of the enquiry, could not be brought within the compafs of the prefent communication.

II.

II. Observations on Granite. By *James Hutton*, M. D. F. R. S. Edin. *and Member of the Royal Academy of Agriculture at* Paris.

[*Read Jan.* 4. 1790.]

SINCE reading the paper upon the theory of the earth *, I have been employed in examining many parts of this country, in order to enquire into the natural hiſtory of granite. In this undertaking, I have ſucceeded beyond my moſt flattering expectations; and I am now to communicate to this Society the reſult of my obſervations.

In the paper juſt referred to, it was maintained, from many different arguments, that all the ſolid ſtrata of the earth had been conſolidated by means of ſubterraneous heat, ſoftening the hard materials of thoſe bodies; and that in many places, thoſe conſolidated ſtrata had been broken and invaded by huge maſſes of fluid matter ſimilar to lava, but, for the moſt part, perfectly diſtinguiſhable from it. Granite alſo was conſidered there as a body which had been certainly conſolidated by heat; and which had, at leaſt in ſome parts, been in the ſtate of perfect fuſion, and certain ſpecimens were produced, from which I drew an argument in ſupport of this concluſion.

At that time, however, I was not perfectly decided in my opinion concerning granite; whether it was to be conſidered as a body which had been originally ſtratified by the collection of its different materials, and afterwards conſolidated by the fuſion of thoſe

* Vid. Tranſ. R. S. Edin. vol. I. p. 209. Phyſ. Cl.

thofe materials; or whether it were not rather a body tranf-fufed from the fubterraneous regions, and made to break and invade the ftrata, in the manner of our whinftone or trapp, and of porphyries, into which the whinftone often graduates.

It was not that I doubted of there being fuch a thing as ftratified granite; the *granit feuilleté* or *granit veiné*, which M. de Saussure has defcribed in his *Voyages dans les Alpes*, is certainly a ftratified granite; and this is very well diftinguifhed by that author, as is the *granit en maffe*, the hiftory of which we are now enquiring after. I had alfo fpecimens of a fimilar veined granite from the North-weft Highlands, that is, from beyond Fort William and the lakes; and this veined granite is ftratified along with the quartzy, micaceous and Alpine ftrata.

But my object was to know if the granite that is found in maffes has been made to flow in the bowels of the earth, in like manner as thofe great bodies of our whinftone and porphyry, which may be confidered as fubterranean lavas. Now, this queftion could only be determined by the examination of that fpecies of granite upon the fpot, or where it is to be found in immediate connection with thofe bodies which are evidently ftratified; bodies, confequently, whofe natural hiftory we have fome means of tracing.

In ftratified bodies, we have not only the means of diftinguifhing thofe which, in point of time or fucceffion of operation, have been formed prior and pofterior, we may alfo, with regard to the manner of operation, diftinguifh thofe ftratified bodies from others which had been introduced among them in a forcible manner, or with marks of violence inconfiftent with the regular procefs of ftratification. Now, the evidence of this muft be found in the broken, feparated and diftorted parts of thofe regularly formed bodies, the natural hiftory of which we fo far know.

This was the queftion, with regard to granite, that I wanted to have refolved by means of the connection of that mafs with the

the Alpine ſtrata; that is to ſay, I wanted to ſee, whether the granite maſs, in point of time, had been prior or poſterior to theſe water-formed bodies; and, as to the manner of operation, I particularly deſired to know, if that granite had been made to flow, in the ſtate of fuſion, among the broken and diſlocated ſtrata.

Having thus ſuſpended my opinion, until I ſhould have an opportunity of finding ſome deciſive appearance, by which this important queſtion might be determined with certainty, I conſidered where it might be moſt likely to find the junction of the granite country with the Alpine ſtrata. Mr Clerk of Eldin and I had an engagement to viſit the Duke of Athol, at Blair. I concluded, that from Blair it could not be far before the great maſs of granite, which runs ſouth-weſt from Aberdeen, would be met with, in aſcending the river Tilt, or ſome of its branches. Mr Clerk and I were, however, reſolved to find it out, to whatever diſtance the purſuit might lead us among the mountains of this elevated track. Little did we imagine that we ſhould be ſo fortunate as to meet with the object of our ſearch almoſt upon the very ſpot where the Duke's hunting-ſeat is ſituate, and where we were entertained with the utmoſt hoſpitality and elegance.

It is in Glen Tilt, and preciſely in the bed of the river, that this junction is formed of the granite with the Alpine ſtrata. But this circumſtance, of being in the bed of the river, where the rocks are often waſhed bare, is of ſuch importance, that had this junction been only to be found in the mountains covered with heath and moſs, we might have been upon the ſpot, and yet been ignorant of the moſt material circumſtances of the fact, which we wanted to explore.

I here had every ſatisfaction that it was poſſible to deſire, having found the moſt perfect evidence, that the granite had been made to break the Alpine ſtrata, and invade that country in a fluid ſtate. This correſponded perfectly with the concluſion

which

which I had drawn from the ſingular ſpecimen of the Portſoy granite *.

It was in the year 1785, that we were thus gratified by a ſight of the junction of the granite with the Alpine ſchiſte, or primary ſtrata, as they may be called, of the north country. We now were eager to ſee the junction of the granite country, which I knew to be at the head of Loch Dune, with the ſchiſtus ſtrata of the ſouth of Scotland. In the year 1786, therefore, Mr Clerk and I ſet out by the ſhire of Ayr, to ſearch round the coaſt of Galloway, in order to find the junction of the granite mountains with the ſchiſtus or vertical ſtrata, of which I knew that Galloway conſiſted.

We were extremely fortunate in finding what we looked for, in two different places in Galloway; firſt, in the mountain of Cairn's muir, between two and three miles from the Ferry-town of Cree; and, ſecondly, in a little bay upon the ſea-ſide, about mid-way between Covend and Saturneſs point on the Solway frith. Here we were as much ſatisfied, as we had been the year before, that the granite had invaded the ſchiſtus or Alpine ſtrata, having not only broken and floated the ſchiſtus in every way poſſible, but in the laſt of thoſe two places, we found the granite introduced, for ſome length, in ſmall veins between the ſtratified bodies, giving every mark of the moſt fluid injection among the broken and diſtorted ſtrata.

In Auguſt 1787, I ſet out for Arran. Mr Clerk could not go at that time, and Mr John Clerk, *junior*, was ſo kind as to accompany me. We had exceeding good weather for exploring the lofty mountains of that iſland, and returned extremely ſatisfied with our expedition.

I propose to give a particular account of the conſtruction of Arran, or a mineralogical hiſtory of it; therefore it will here only be neceſſary to ſay, that I found my former concluſions fully confirmed by all the appearances in this moſt intereſting iſland; and I brought ſpecimens with me, ſome of them of great ſize,

* Tranſ. R. S. Edin. vol. I. p. 255. Phyſ. Cl.

ſize, which to every perſon who has ſeen them, leave no manner of doubt with regard to the propoſition which I have maintained.

We are now fully aſſured that granite has been made to break, diſplace and invade the Alpine ſchiſtus or primary ſtrata having been previouſly forced to flow in the bowels of the earth, and reduced into a ſtate of fuſion. From this too we are to draw the following concluſion:

Granite, which has been hitherto conſidered by naturaliſts as being the original or primitive part of the earth, is now found to be poſterior to the Alpine ſchiſtus; which ſchiſtus, being ſtratified, is not itſelf original; though it may be conſidered, perhaps, as primary, in relation to other ſtrata, which are evidently of a later date.

The ſucceſſive operations of the globe, in producing, deſtroying and replacing ſtrata, for the purpoſe of land, are a ſubject of natural hiſtory moſt intereſting to every theory of the earth. The view of granite which has now been given, forms one great ſtep in this enquiry; and it is connected with ſome other very important facts with regard to the ſucceſſions of ſtrata, or a certain order of geological periods, which may be aſcertained by the natural hiſtory of our minerals. Of this I ſhall alſo treat in another place; and I wiſh what I now lay before the Society, to be conſidered merely as a notice given of certain new facts and obſervations, which I mean fully to deſcribe and explain hereafter.

[*Read Aug.* 1. 1791.]

SINCE reading the mineralogical notice in this Society with regard to granite, I have found that the ſame curious appearance, which had occurred in the granite of Portſoy, (deſcribed in the firſt volume of theſe Tranſactions, and referred to above), has been obſerved in a very diſtant part of the world. In the Journal de Phyſique, Avril 1791, M. PATRIN deſcribes a granite mountain in the eaſtern part of Siberia, where we meet with the following account:

" ENFIN, l'on trouve dans les parois de ce filon, cette eſpèce " ſingulière de roche qu'on a nommée *pierre graphique:* c'eſt " un feld-ſpath dans lequel ſe trouvent une multitude de petits " criſtaux quartzeux, tous à-peu-près du même volume, et " placés dans le même ſens, avec une ſorte de regularité. Ces " criſtaux n'ont de quartz que la carcaſſe; l'interieur eſt de " feld-ſpath: le plus ſouvent même il manque pluſieurs faces " des criſtaux; de manière que quand on coupe la pierre tranſ- " verſalement, elle preſente une ſuite de figures qui ſont des " portions d'hexagones, ce qui ne reſſemble pas mal à de l'écri- " ture. J'en ai un échantillon qui imite ſi bien les caractères " Hebraïques, que quelqu'un a dit en la voyant, que certaine- " ment c'étoit un morceau des tables de MOYSE.

" ON trouve la même pierre aux environs d'Ekaterinbourg, " dans les Monts Oural, qui ſert également de liſière à un filon " de topaſes; ce qui me feroit ſoupçonner qu'elle eſt un indice " de cette gemme. J'ai vu à Paris, dans la belle collection de " M. BESSON, des échantillons de *pierre graphique*, venant de

" Corſe;

" Corſe *; peut-être y trouvera-t-on quelque jour des to-
" paſes."

M. PATRIN has repreſented this ſpecies of cryſtalization in a different light from that by which I had endeavoured to explain the appearance of this ſtone. He conſiders the quartz as cryſtalizing in its natural hexagonal ſhape, and thus including bodies of feld-ſpar; whereas I think that it is the ſparry ſtructure of the laſt that had induced a certain form upon the quartz, a form which is neither the natural ſhape of the cryſtalization of that ſiliceous ſubſtance, nor an accidental ſhape, that had ariſen from preceding cauſes, but a ſhape determined by the concretion of this mixed body cryſtalizing from the fluid ſtate of fuſion. Indeed, I ſee nothing in the ſpecimens which we poſſeſs, that can juſtify M. PATRIN's ſuppoſition; on the contrary, almoſt every appearance is inconſiſtent with it. I ſhall mention only one.

IF the figuring cauſe, which proceeds longitudinally through the ſtone, were that of the ſiliceous cryſtalization, then the tranſverſe ſection would exhibit hexagonal figures of quartz, incloſing bodies of feld-ſpar. Now, M. PATRIN ſays, that ſeveral of thoſe ſides of the hexagons are wanting; but then what remains ſhould be conformable to that hexagonal figure of which it was a part. This, however, I think, is not the caſe; and in the ſpecimens which I have, the rhombic angles of the feld-ſpar ſeem ſo prevalent in the figures, and theſe *Hebrew* or rather *Runic characters* are ſo regularly directed by two lines correſponding with the rhombic angle, that I cannot help aſcribing this regular figure to that cauſe, and not conſidering it as produced by the obtuſe angles of imperfect hexagons. It is

* I am inclined to believe that this ſpecimen, which is here repreſented as coming from Corſica, is no other than the granite of Portſoy which I have deſcribed. I imagine that here is only a graphic error, in writing *de Corſe*, in place of *d'Ecoſſe*.

is true indeed that there are many of thefe angles obtufe ; but there are an equal number, which are as much lefs than the right-angle, as the others are greater.

In whichfoever of thefe two lights we are to take the explanation of this mineral appearance, my argument, *viz.* that thefe two fubftances had concreted together from a fluid ftate of fufion, is equally fupported. For whether cryftalizing quartz fhall inclofe a body of feld-fpar, or concreting feld-fpar determine the fhape of fluid quartz ; particularly, if we have, as is here alfo the cafe, two folid bodies mutually including and included by each other, it amounts to a demonftration, that thofe bodies had concreted from the fluid ftate of fufion, and had not cryftalized in the manner of falts from a folution. Therefore, here is the teftimony of granite from three different places of the earth, *viz.* from the Daouri, from the Oural Mountains, and from Scotland, by which this truth is manifefted.

It would feem that the circumftances, neceffarily concurring in order to produce this particular effect, are rarely to be found ; and the external circumftances which attend it in the eaft, do not appear to accompany it in the weft of Europe. In Scotland, this ftone neither forms the walls of a vein, nor are topazes found connected with it, as M. Patrin found it in the eaft. The internal circumftances, therefore, which, in the mafs of granite, determine this particular conftruction of the ftone, are to us unknown.

It is not, however, confined to any particular place or fituation ; it is found both at the level of the fea, and upon the higheft parts of the earth, and in countries extremely diftant from each other. Now, confidering that nothing is more general in minerals than granite, it is furprifing that this particular modification of its conftituent parts has been fo little obferved. But, as it would feem to take place only in fmall portions of the granite mafs, there may be fimilar examples in many maffes, or in moft granite

nite countries, without their having as yet appeared to the view of naturalifts ; and I am perfuaded, that many will be difcovered, if it fhould be made an object for the enquiry of thofe who have the opportunity of examining this fubject.

IV.

III. *Of the* FLEXIBILITY *of the* BRAZILIAN STONE. *By* JAMES HUTTON, M. D. F. R. S. EDIN. *and Member of the Royal Academy of Agriculture at* PARIS.

[*Read Feb.* 7. 1791.]

NO quality is more inconfiftent with the character of a ftone than flexibility. A flexible ftone, therefore, prefents an idea which naturally ftrikes us with furprife. For though among mineral bodies, we find flexible fubftances of the ftony kind, fuch as mica, mountain leather, and amianthus, thefe minerals owe their flexibility, either to their thinnefs, or to the fibrous ftructure of their parts. Therefore, when a ftone of any confiderable thicknefs is faid to have flexibility, we are led to think that here is fomething very extraordinary; and we wifh to know upon what depends that quality, nowife proper to a ftone.

SUCH, however, is the ftone from Brazil, of which the Baron de DIETRICH read a defcription in the Royal Academy of Sciences, in January 1784. There is alfo at prefent, in the poffeffion of Lord GARDENSTON, a fpecimen of ftone, which correfponds with that defcription, inferted in the Journal de Phyfique for the year 1784*. The length of the ftone which I have examined is twelve inches, the breadth about five, and the thicknefs half an inch. When this ftone is fupported by the

* Tom. xxiv. p. 275, 276.

the two ends in a horizontal poſition, the middle part bends by its own weight more than a quarter of an inch from the ſtraight line. This ſpecies of flexibility may certainly be made a proper object of ſcientifical inveſtigation. I am therefore induced to lay before this Society what has occurred to me upon the ſubject.

Hard bodies are either on the one hand friable, or on the other ductile. If they are friable, they are elaſtic; if ductile, again, they preſerve the change which has been forcibly induced upon their form, conſequently are not in that ſenſe elaſtic. Bodies, indeed, may be either friable or ductile in various degrees; but, ſo far as friable, they are not ductile; and, ſo far as ductile, they cannot be ſaid to be elaſtic. But compound bodies may be flexible, without being either ductile or elaſtic; ſuch are jointed bodies. In that caſe, however, it is not to the nature of the ſubſtance that the body owes its flexibility, but more properly to its mechanical conſtruction. Of this kind, certainly, is the body which we have now under conſideration; for it has a certain flexibility, to which neither the terms *ductile* nor *elaſtic*, will properly apply; although, having no degree of ductility from the nature of its ſubſtance, it cannot, in like manner, be ſaid to have no elaſticity. The flexibility of this ſtone is ſo eaſy, compared with the rigidity of its ſubſtance, and its elaſticity ſo ſmall, compared with its flexibility, that there muſt be in this body ſome mechanical ſtructure, by which this unnatural degree of flexibility is produced; that is to ſay, a flexibility which is not inherent in the general ſubſtance of the body.

Now, the ſubſtance of this ſtone being chiefly quartz, the moſt rigid and inflexible of all materials, and the ſtone, at the ſame time, bending in ſuch an eaſy manner, there is reaſon to conclude, that this ariſes from no principle of flexibility in the general ſubſtance of the ſtone, but from ſome ſpecies of articulation in the ſtructure of it, or among its conſtituent parts; which articulation

articulation, while it preferves the component particles in one entire mafs, fuffers the parts to move a certain fpace in relation to each other.

But before diffecting this ftone, in order to fee upon what principle it holds its flexibility, it may be proper to form a diftinct idea with regard to that inflexibility or rigidity which is to be found in other ftrata.

We do not now enquire into the means employed by nature for uniting the incoherent particles of which our ftrata have been compofed; it is enough to know this fact, That ftrata are thus actually found, with their particles united in every poffible degree, from the flighteft contact to the moft abfolute confufion; that is to fay, from a mafs of incoherent particles, they become bodies of the moft perfect folidity, and may be found in every fenfible ftage of that progrefs. If they are flightly cemented, the ftone is tender and extremely friable; if much confolidated, the ftone is ftrong, but inflexible, that is to fay, with no more flexibility than the nature of the fubftance and the thinnefs of the body will admit of. It will here be evident, that with the fame degree of cementation or confolidation, and with the fame fubftance, the ftrength of the ftone will depend upon the figure of the particles of which it is compofed; the fpherical being that in which the particles are leaft difpofed to be firmly united. But of whatever form the particles may be, or in whatever degree they may be cemented, fo long as their parts, which are in contact, are united, and fo long as thofe particles are rigid, no flexibility, at leaft of that kind which is the fubject of the prefent examination, can take place.

Thus we may fee, that in order to give any degree of the prefent flexibility, it is neceffary the particles fhould not be all equally united, but be united in fome parts, and difunited in others. By this means, a certain fpecies of articulation may be formed; an articulation which muft be of a complicated nature,

ture, depending upon many circumſtances; and one which it may be very difficult to inveſtigate among the ſmall particles of this ſtone.

We are now to endeavour to diſcover the peculiar ſtructure or conſtitution of this Brazilian ſtone, by examining, as minutely as we can, the form and ſubſtance of its conſtituent parts, and that particular texture by which they are united.

Upon the upper and under ſurfaces of this thin ſtratum of ſtone, there is to be perceived a certain ſtructure, which has a reſemblance to a fibrous ſtructure, but which is truly not fibrous. From more accurate inſpection, it appears to ariſe from the reflection of longitudinal ſpecular plates, which are all regularly arranged in one direction, conſequently are parallel to each other. This gives ſome reſemblance to a fibrous ſtructure.

When I examined theſe places with a microſcope, I could perceive nothing like mica in them; but they ſeemed to me to be the impreſſion of mica which had ſo formed the tranſparent ſubſtance of the ſtone. In examining the tranſverſe ſection of the ſtone, there appears nothing heterogeneous in its conſtitution, nothing micaceous, nor any diſtinct mark of ſtratification. The ſtone is porous or ſpungy, ſeemingly compoſed of nothing but pure tranſparent quartz, and ſhows neither a fibrous nor a laminated ſtructure. It reſembles nothing ſo much as a compreſſed ſtratum of ſnow. I now almoſt gave up every ſuſpicion of mica in the compoſition of this ſtone; and this will ſerve to ſhow how deceitful may be certain appearances.

My next operation was to ſplit this ſtone in the direction of its ſtratification, by preſſing in the point of a knife. Here I found that this ſtratified body has truly a foliated ſtructure, and a certain tenacity in the direction of its ſtratification, which admits of flexure before it breaks. The ſame ſtriated appearance is here to be perceived in the internal horizontal ſection, as was obſerved upon the upper and under ſurfaces of this ſtra-

tum ; and this appearance likewiſe proceeds from the ſame kind of ſpecular longitudinal plates, arranged in the ſame order.

I NOW beſtowed ſome pains in endeavouring to diſcover, by the power of the lens, what was the nature of thoſe reflecting ſpecular laminæ ; but I could not ſay aſſuredly, that there were two different ſubſtances in the conſtruction of this ſtone. The irregular quartzy particles, and theſe ſpecular bodies, ſeemed both to be of a perfectly tranſparent cryſtalline-like matter. I then had recourſe to the blow-pipe, in order to reſolve my doubts ; and this indeed ſoon made a diſtinction of the different ſubſtances contained in this ſtratum. Where the fragment of the ſtone had received the intenſe heat of the flame, the foliated ſpecular ſtructure totally diſappeared ; and here the irregular quartzy particles remained ſeemingly without change. In the other part of the fragment, which had been heated to incandeſcence, the doubt with regard to the ſpecular bodies was entirely removed, and the tranſparent mica had now aſſumed its natural appearance ; it had become opake with regard to the tranſmiſſion of light, at leaſt comparatively, and it gave an argentine appearance by reflection, as may be perceived in the ſpecimens which I have here laid before the Society.

I NOW could ſee, moſt evidently, the connection of the irregular ſtructure of the quartzy particles, with thoſe ſtratified parallel plates of mica ; and I alſo underſtood the reaſon why I could not before diſtinguiſh the proper connection of thoſe two ſubſtances, which was no other than their perfect tranſparency. But being thus ſatisfied of the thin flexible plates of mica, we may now conſider the particles of quartz, which have little coheſion, as being bound together by theſe thin plates of tranſparent mica ; and theſe connecting plates being flexible, this allows a certain motion of the rigid particles among themſelves, without the fracture or general ſeparation of the ſtone.

WERE

WERE I to form a conjecture in relation to the natural history of this flexible Brazilian ſtone, I would ſuppoſe, that it had been originally, like many ſimilar ſtrata, attendant upon the Alpine limeſtones, conſolidated with calcareous ſpar; and that the conſolidating ſubſtance had been afterwards diſſolved out, as it always is in ſtones ſufficiently expoſed to the influences of the atmoſphere. This ſuppoſition is alſo countenanced by the report, which I have received, with regard to the ſituation in which this ſolitary ſtone was found. It is ſaid to have been in the ſoil or upon the ſurface of the earth. But without allowing ourſelves to be led into any hypothetical ſpeculations upon the ſubject, we may now reaſon from what appears more evident in the conſtruction of this mineral.

NOTHING is more common in our north Alpine country, as well as in every other extenſive country of the ſame kind, than ſtrata of granular quartz and mica; and in our low country, we have many micaceous ſand-ſtones; yet ſtones of that kind, with palpable flexibility, have not been obſerved. Therefore we have reaſon to believe, that it requires many conditions, ſeldom to be found together, in order to produce that flexibility which is ſo remarkable in this Brazilian ſtone. It is not enough to be compoſed of ſiliceous particles and plates of mica; theſe muſt be duly proportioned and properly arranged. But when all the materials ſhall be juſtly proportioned and perfectly arranged, perhaps the moſt difficult part is ſtill to come; that is, the giving a proper union to the parts, ſo as to form a cohering ſtone, at the ſame time that the proper ſeparation among thoſe parts is ſo preſerved as to allow them to move in relation to each other. Were all the particles united or cemented where they are in contact, it is plain that the flexibility of this ſtone would be loſt; and were there no union among the component particles, it would ceaſe to be a ſtone; a term which implies a certain degree of conſiſtency or ſtrength. But between thoſe two extremes, there are not only many degrees,

but alſo a certain variety, ariſing from different modifications of thoſe conditions. Thus, for example, the plates of mica may be united with the particles of quartz, while theſe inflexible particles are not united with each other. Here is a modification which may alſo take place in various degrees ; for part of the quartzy particles may be cemented, while there is ſufficient ſeparation upon the whole, to admit of all the flexure which is here perceived.

I MAKE little doubt that ſomething of this kind is the caſe with the preſent example ; that is to ſay, that there is a ſufficient connection among the parts to preſerve the proper conſiſtency of a ſtone, and a ſufficient laxity in the compoſition to admit of many of its parts moving in relation to each other, at the ſame time that the whole is connected.

BUT if among the indefinite variety that may happen in the diſpoſition of thoſe materials, and in the ſtill more various degrees in which the cementing or conſolidating operation may proceed, there is but one in which the greateſt degree of flexibility may be admitted of, we ſhall find reaſon to conclude, that while an example equal to the preſent may be extremely rare, yet that upon accurate obſervation, many ſtones of that kind may be found to poſſeſs ſmall degrees of this ſpecies of flexibility, ſuch as might paſs unnoticed by common obſervation.

THE *ſtellſten* or *geſtellſtein* of the Swedes and Germans, which they employ for the building of furnaces, is a ſtone of this kind, being, according to CRONSTEDT, compoſed of quartz and mica. Let us now conſider what is the quality in a ſtone which, beſides being apyrous, is required in order to adapt it to that purpoſe, of being durable in a furnace. It is preciſely the ſame quality that would procure a certain degree of flexibility to the ſtone. In proportion as a ſtone is ſolid and friable, it is improper for that purpoſe. But in a porous ſtone, there is alſo a certain texture that adapts it for reſiſting the alternate operations

operations of heat and cold, or the effects of frequent expansions and contractions, partially applied. Now, it is precisely the same structure which is required for those two purposes, that of procuring flexibility, and that of resisting fracture by the partial application of heat and cold; and the two things here compared, the stellsten and the Brazilian stone, are of the same construction, so far as composed of quartz and mica in the stratified structure of a schistus.

Now, though in comparing the common stellsten, or quartzy micaceous strata of the Alpine countries, with this Brazilian stone, the one may be said to be flexible and the other inflexible, this is but saying that the one of these is not sensibly flexible, as is the other. But how many degrees of flexibility may actually take place between that which may be sensible to common observation, and that at which flexibility must cease?

THEREFORE, in seeing the principle upon which the Brazilian stone possesses its flexibility, we may understand the quality of the stellstein which renders it so proper for the construction of furnaces; and, conversely, in understanding the structure of the stellsten, we may see the principle upon which the Brazilian fossil possesses flexibility in so eminent a degree.

BUT it would appear, that this is not the only species of stone which may have this remarkable degree of flexibility. M. le Baron de DIETRICH observes, that the marble tables, preserved in the Borghesé Palace at Rome, under the name of *Pietra elastica*, seem to have the same property. Now, M. FERBER found, that those tables were of a true antique white marble, the grains of which have but little cohesion; and the P. JAQUIER observed, among the grains of the marble, particles of talc. But among the Alpine strata, we find both those that are composed of granulated quartz and mica, and those that are composed of granulated calcareous spar and mica, so much resembling each other, that, without trying their hardness or their solubility in acids, it would be difficult to distinguish them.

them. While, therefore, the flexibility of thofe ftratified bodies is confidered as arifing from a certain mechanical conftruction, in which flexible plates of talc or mica are united with the granulated body of the ftone, it is of no confequence of what fubftance the rigid particles of the ftone fhall confift, fince they do not alter their form during the flexure, but only move in relation to each other.

IV.

IV. *An* ANALYSIS *of the* WATERS *of ſome* HOT SPRINGS *in* ICELAND. *By* JOSEPH BLACK, M. D. *Profeſſor of Medicine and Chemiſtry in the Univerſity of Edinburgh, Firſt Phyſician to his Majeſty for Scotland, Fellow of the Royal College of Phyſicians, and of the Royal Society of Edinburgh; Member of the Academy of Sciences and of the Society of Medicine of Paris, of the Imperial Academy of St Peterſburgh,* &c. &c.

[*Read July* 4. 1791.]

SIR JOSEPH BANKS, to whoſe indefatigable ardour for the advancement of natural hiſtory, the philoſophical world is ſo much indebted, made a voyage to Iceland in the year 1772, to enquire into the productions of that remote part of the world, and particularly into thoſe of its famous volcano. When he returned, he brought from thence, among many other natural productions, ſome petrified vegetables, and incruſtations, formed by the waters of the boiling ſprings; and he was ſo good as to preſent a part of them to his friends here, who were ſurpriſed to find them compoſed of ſiliceous earth. As this was the firſt example obſerved, of water containing this earth in ſuch quantity as to form ſiliceous petrifactions, it raiſed a ſtrong deſire to have an opportunity of examining the water, and of learning by what means this ſiliceous matter was diſſolved in it; and this opportunity was at laſt given us by JOHN THOMAS STANLEY, Eſq; who, excited by motives ſimilar to thoſe of Sir JOSEPH BANKS, equipped likewiſe a veſſel, and made a voyage to Iceland, during the ſummer 1789. He brought

brought from thence, and from the Faro Iſlands, a number of fine ſpecimens of volcanic and other foſſil productions, and along with them, a quantity of the water of the two moſt remarkable boiling and exploding ſprings of Iceland, called by the natives *Geyzer* and *Rykum;* and having favoured me with a portion of theſe waters, and expreſſed his deſire that I would examine them, I have accordingly made a number of experiments with them, an account of which I ſhall now ſubmit to the Society. If the detail of it ſhould appear tedious ; if I ſhall be thought to have given much attention to very ſmall matters ; it muſt be conſidered, that the nature of the ſubject requires exactneſs. The quantities of the materials which are to be examined in ſuch experiments, are but ſmall, though it often happens, that theſe ſmall quantities of matter, acting in nature for a great length of time, produce accumulations, and other effects, that appear very ſurpriſing and worthy of attention. I muſt alſo confeſs, that I took pleaſure in promoting, as far as I could, the information concerning Iceland, which the philoſophical zeal and ſpirit of the Gentlemen I mentioned, have procured for us.

Both theſe waters had a weak ſmell of the Hepatic Gas, or a ſmall degree of the odour, which is well known in Harrowgate, and other ſulphureous waters. The quantity, however, of this ſulphureous matter in them was ſo very ſmall, that I was not able, by any experiments, to obtain it in a ſeparate ſtate, or bring it into view in any form whatever. I therefore could not make any attempt to eſtimate the quantity of it.

Those who are acquainted with ſulphureous waters, know that an incredibly ſmall quantity of their volatile ſulphureous matter is ſufficient to give a perceptible odour; and it is ſo liable to be decompounded and changed, while we attempt to ſeparate it from water, that ſuch an attempt never ſucceeds when the quantity of it is ſmall. There was alſo reaſon to believe, that ſome part of it had already been loſt or changed during the

voyage;

voyage, this matter being one of thofe volatile ingredients of mineral waters, which are the moft liable to be evaporated or changed by the action of the air and other caufes. I therefore think it fufficient to mention, that thefe waters contained a fmall quantity of this fubftance.

I BEGAN by making a few preliminary trials, to acquire fome notion of the nature of thefe waters.

1. AN equal quantity of lime-water being added to the Iceland waters, there was a little diminution of tranfparency, but only in the fmalleft degree, and no fediment was formed.

2. MILD volatile alkali produced no effect whatever.

3. PAPER ftained blue with the March violet, being dipped into the water and dried, had its colour changed a little towards a green.

4. CAMBRIC ftained to a bluifh purple, with infufion of litmus, affumed a more perfect blue colour, when dipped into the water and dried.

5. ACID of fugar did not produce a perceptible muddinefs or precipitation.

6. NOR did the folution of corrofive fublimate.

7. THE folution of fal faturni (plumbum acetatum) made the water very muddy and white, but a fmall quantity of diftilled vinegar rediffolved nearly the whole of the precipitate, and made the water almoft perfectly clear again.

8. THE folution of barytes in muriatic acid made the water become muddy, and depofite a fediment, which was not rediffolved by adding purified nitrical acid.

9. THE folution of filver produced a ftrong muddinefs and confiderable precipitation, which was not rediffolved by adding purified nitrical acid.

THE laft trial fhewed the prefence of the muriatic acid, and the one preceding it, that of the vitriolic acid in the compofition of thefe waters; but by the 3d, 4th and 7th, I alfo learned, that there was more than enough of alkaline matter to faturate

both of them. The 5th trial ſhewed that the alkaline matter was not calcareous earth, but alkaline ſalt; and the 6th, that this alkaline ſalt was not the volatile, but one of the fixed alkalis. The 1ſt trial ſhewed, that this unſaturated fixed alkali was not combined with air, or that if any was combined with it, the quantity was ſo ſmall as to be ſcarcely perceptible.

None of theſe trials gave any indication of the earthy matter contained in theſe waters; and as my principal object was to inveſtigate the nature of their petrifying power, I now began with the following experiment:

Evaporation of the Water.

I evaporated 10,000 grains weight of each of theſe waters to dryneſs with a gentle heat, in ſeparate glaſſes. The dry extract of the water of Rykum weighed gr. 8.25, and that of Geyzer, gr. 10.

The evaporation was performed in cylindrical glaſs veſſels, about 3 inches wide and 7½ deep, which received heat from the ſteam of boiling water, not directly, but through the intervention of white-iron caſes, which fitted the glaſſes, and in which they hung. I have often uſed this apparatus in examining and comparing different waters; and the advantages of it are, that the greater part of the fixed matter is collected on a ſmall ſurface; that the glaſſes are ſo moderately heated, that they bear water to be added, during the evaporation, without danger of breaking; and, laſtly, when the whole water is evaporated, the fixed matter, while it is thoroughly dried, by leaving it expoſed ſome hours to the heat, never becomes ſo hot as to ſuffer the loſs of any part of the acid of the ſaline compounds which it may contain, and when it is dry, the quantity of it is accurately determined, by weighing it in the glaſs, the weight of which can

be

be aſcertained, both before the water is put into it, and after the extract is taken out.

In the end of theſe evaporations of the Iceland waters, they emitted an odour ſimilar to that of alkaline leys, which contain an alkali not very pure or well calcined, and afterwards, when the evaporation was nearly completed, the reſiduum aſſumed the form of a tranſparent jelly, which had nearly the thickneſs of half a crown. This jelly afterwards became divided by fiſſures, into a great number of ſmall portions, which, in drying, contracted their ſize, and greatly widened the fiſſures, forming at laſt a number of ſmall fragments of white cruſt, unconnected with one another, and not adhering to the bottom of the glaſs. A ſmall quantity only of this matter attached itſelf to the ſides of the glaſs during the evaporation, and formed there circles of an exceeding thin incruſtation, which adhered ſtrongly, and required much patience to ſcrape it off with a knife.

These phenomena are exactly ſimilar to thoſe which appear in evaporating water which contains ſiliceous earth, diſſolved in it artificially by means of an alkaline ſalt. The colour of the dry matter obtained from Rykum water, was almoſt a pure white, that of the water of Geyzer was a yellowiſh white.

While theſe dry extracts were kept for ſome time in the glaſſes, placed in a cold room, in the winter ſeaſon, they attracted humidity, and the extract of Geyzer attracted the moſt. Eight grains of the extract of Rykum attracted in one week four grains of humidity; the ſame quantity of the extract of Geyzer attracted in the ſame time ten grains of humidity. My attention, however, was turned for ſome time from theſe experiments; but reſuming them again after ſome months, I found that theſe extracts remaining in the ſame glaſſes, and in the ſame room, had again become dry, and had loſt the greater part of the weight which they had acquired at firſt by attracting humidity. This I imputed partly to the ſtate of the atmoſphere, and partly to their having attracted fixed air, by their

union with which they had loſt their ſtrong attraction for water.

The conſtituent parts of theſe extracts were next to be inveſtigated. I ſoon perceived that they contained a portion of alkaline ſalt not ſaturated with acid, which became evident when a ſmall quantity of them was wetted and applied to paper ſtained with the juice of violets, or the colouring matter of the common purple radiſh; the colour in either caſe was changed to a green, I further collected and ſcraped theſe extracts out of the glaſſes, and placing each in a ſmall filtre, I dropped diſtilled water on them repeatedly, until the water came away from them inſipid. The waters which had been thus filtrated through them were put into china cups, and the greater part evaporated with a gentle heat, the reſt was allowed to evaporate ſpontaneouſly in a dry room. Thus, a number of ſmall ſaline cryſtals were formed, which were partly regular cryſtals of common ſalt, and partly cryſtals of an oblong and flatted form, larger than thoſe of the common ſalt. Theſe larger cryſtals were diſtinguiſhable, not only by their form, but by ſome of their properties. They became white, opaque and mealy in dry air, and being taken out, and taſted and tried in different ways, were found to contain ſome of the foſſil alkali in a cryſtalized ſtate.

The undiſſolved matter which had remained on the filtrating paper, appeared by its properties to be totally or principally made up of ſiliceous earth. It was white and exceedingly ſpungy and light. A ſmall portion of it was triturated, and made into a paſte with water; which paſte being laid on a piece of charcoal and dried, was heated intenſely with the blowpipe. No part of it was melted; it was only contracted in its dimenſions, and acquired a weak degree of coheſion. Another ſmall portion was triturated dry, with an equal weight of aerated and exſiccated foſſil alkali: and being put into a ſmall platina ſpoon, againſt the bottom of which the flame of the blowpipe was ſtrongly

ſtrongly directed, the mixture was ſoon melted into a tranſparent colourleſs glaſs, which afterwards, by being digeſted with a ſmall quantity of diſtilled water, was completely diſſolved, and formed a liquor which had all the qualities of the *liquor ſilicum.*

I NEED not take notice here of the quantity of the earth and ſaline matter which were in ſome meaſure ſeparated from one another in this experiment. I had reaſon to ſuſpect, that neither of them were obtained in this way without ſome loſs. The odour emitted by the water in the end of evaporation, gave reaſon to ſuſpect the loſs of ſome part of the ſalts; and it was probable that a part of the earth would remain combined with the alkali, in a ſoluble ſtate, in the dry extract, and would paſs through the filtre, when I diſſolved and waſhed away the ſaline matter.

I THEREFORE planned a ſet of experiments, by which the quantity of each ingredient in theſe waters might be more certainly known; and began with the following

Experiments to inveſtigate the quantity of the un-neutralized alkaline ſalt.

IN making the experiments to decide this queſtion, I made uſe of an acid, which I had often employed before in experiments to learn the quantity of pure or cauſtic alkali, contained in aerated alkalis, and in various barillas, kelps, and other ſuch heterogeneous maſſes. This acid was a quantity of the vitriolic, the power of which, in ſaturating pure alkalis, I had carefully examined, and I was accuſtomed to add it very gradually to filtrated ſolutions of the above ſubſtances, until they were exactly ſaturated; and then, from the quantity of acid required to produce this effect, I learned the quantity of un-neutralized alkali which theſe ſubſtances contained. The ſpecific gravity of this

vitriolic

vitriolic acid, compared with that of water, was as 1798 to 1000, in a temperature of heat equal to 60 of FAHRENHEIT. When I had uſed it on former occaſions, I diluted ſome of it, with four times its weight of diſtilled water, and uſed this mixture in place of the pure acid, that I might the more readily portion it into ſmall dozes; but on this occaſion, I made a mixture of it, with about 100 times its weight of diſtilled water; and eſſaying this mixture afterwards, with great attention, I found that 112 grains of it ſaturated one grain of the pure alkaline part of the alkali of tartar, and 171.55 grains were required for the ſaturation of one grain of the pure or cauſtic part of the foſſil alkali.

WITH this largely diluted acid, the ſtrength of which was thus aſcertained, I began to inveſtigate the quantity of alkali in the Iceland waters. I gave a pale purple or blue colour to a portion of the Rykum water, by adding a few drops of an infuſion of litmus, the bluiſh purple of which became more blue when mixed with this alkaline water, and I began to add very gradually ſome of the largely diluted vitriolic acid, expecting to ſee the colour change to a reddiſh purple, when the alkali became completely ſaturated. This method, however, did not ſucceed ſo well as I had ſuppoſed; for although I changed the colour to a reddiſh purple, or even to a pure red, by adding an exceeding ſmall quantity of the diluted acid, the red thus produced was not permanent. Next day, I found it returned again to the blue, and requiring a new addition of acid; and this happened ſo often, after repeated additions of acid, that this proceſs appeared very tedious, and ſcarcely capable of being brought to a preciſe limit; for in proportion as I continued the proceſs the longer time, or had made the more numerous additions of acid, the time neceſſary for the return of the colour from red to blue was always the longer, and at laſt was no leſs than ſeveral weeks.

THESE

These phenomena appear to me to have proceeded from the very weak and ſlow action of the acid and alkali on one another, in conſequence of the exceſſively diluted ſtate in which they were mixed together, the alkali at the ſame time not being pure, but combined with the ſiliceous earth, a ſubſtance for which it has a conſiderable attraction. I therefore ſuppoſed that when I added the ſmall doſes of diluted acid, the acid particles remained for ſome time diſperſed through the liquor, without joining the alkali, and the water contained, at the ſame time, a ſilicated alkali, if I may ſo call it, and an unſaturated acid; but the colour of litmus being much more diſpoſed to be affected and changed by acids than alkalis, it became red, and retained this colour as long as any particles of the acid remained unſaturated. Theſe, however, after ſome time, being all attracted and ſaturated by the alkali, the colour was again changed by the remaining unſaturated alkali.

It may perhaps be ſuſpected, that a ſmall quantity of fixed air, detached from the alkali, might be the cauſe of this temporary red colour, and that the colour returned again to blue, when the fixed air evaporated from the water: And I know that a very ſmall quantity of fixed air, contained in water, is ſufficient to change the colour of litmus, and that a conſiderable time is required for its evaporation from the water, ſo that the litmus may recover its natural tint; but it is equally true, that the fixed air never requires ſo long a time for its evaporation as ſeveral weeks, and that it has not the power to redden litmus, when an alkali is preſent, except when the quantity of the alkali is exceedingly ſmall, and that of the fixed air incomparably more than ſufficient for ſaturating the alkali. In the preſent caſe, the laſt of theſe conditions never could take place, the quantity of acid added at once being far too ſmall to detach enough of air, even although the alkali had been originally ſaturated with air, which it certainly was not; it appeared rather to be in a cauſtic ſtate, or very nearly cauſtic. This reaſoning

ſuggeſted

ſuggeſted to me another mode of making the experiment, which ſucceeded perfectly in a moderate time.

The foregoing experiments, and others which I made with ſmall quantities of the water, enabled me to form ſome judgment of the proportion of acid neceſſary to ſaturate the alkali which this water contained. I therefore added to 10,000 grains of the Rykum water, 200 grains, accurately weighed, of the largely diluted vitriolic acid; which quantity I judged to be conſiderably more than ſufficient for ſaturating the alkali of this water; and after the acid was poured in, the ſmall and light glaſs in which it was weighed, was rinſed ſeveral times with diſtilled water, which was added to the Rykum water. I alſo gave it a pale tincture with ſome drops of the infuſion of litmus, and then boiled the water gently in a thin bottomed glaſs, until it was reduced to one fourth of its firſt quantity. It ſtill continued of a red colour, without the leaſt tendency to a purpliſh hue, and ſhewed that the acid was more than enough to ſaturate the alkali.

It was neceſſary, in the next place, to learn with certainty how much of the acid had been ſuperfluous. With this intention, I added a largely diluted ſolution of alkali of tartar in diſtilled water. In this ſolution, the pure alkali, conſidered as diſtinct from the air which was joined to it, conſtituted one fortieth part of the weight of the fluid. I weighed 38.6 grains of this ſolution; which quantity I knew, by the previous experiments, was exactly or nearly ſufficient for ſaturating the ſuperfluous acid. I poured it at once into the hot water, and rinſing the ſmall and light glaſs in which it was weighed two or three times with diſtilled water, I poured in this alſo. A little effervеſcence appeared in the hot water. I therefore ſet it again on the furnace to boil, that the fixed air might be expelled, and I added now and then a little diſtilled water, to prevent it from boiling down too much. In leſs than half an hour's boiling, the fixed air being all expelled, the colour changed

changed from red to purple, with a very ſmall tendency towards the red. This ſhewed that the quantity of ſalt of tartar, which had been added, was exactly ſufficient for ſaturating the ſuperfluous acid. Had the ſaturation not been ſufficiently exact, I could have added a little more of the alkali, or a little more of the acid, as I had done in the ſmaller eſſays which were preparatory to this; but the tint of colour which I had here produced, was that which I had found to be the moſt diſcernible and ſatisfactory ſign of exact ſaturation, in former experiments; and it is proper to mention, that one grain more of the largely diluted vitriolic acid changed this purple very remarkably to a more decided red, and that with one grain leſs, the hue of the purple, by being inclined to blue, would have been equally diſtinguiſhable; of which I ſatisfied myſelf, by adding as much of the ſolution of ſalt of tartar as ſaturated one grain weight of the largely diluted acid.

The quantity of the diluted acid added at firſt was 200 grains. From this was to be ſubſtracted 108.32 grains, the quantity ſaturated by the 38.6 grains of the ſolution of ſalt of tartar; the remainder is gr. 91.68. From this quantity, however, we muſt make another deduction; for, as Profeſſor Bergman juſtly obſerved, the infuſion of litmus contains ſomething which is of an alkaline nature, or is capable of ſaturating a certain quantity of acid. To learn how much was to be deducted on this account, I tinged a ſmall quantity of diſtilled water, with the ſame number of drops of the infuſion of litmus that I had uſed in tinging the Iceland water, and then making the diſtilled water boiling hot, I began to add ſome of the largely diluted vitriolic acid, and kept the water boiling all the time. The firſt additions of acid, as I expected, did not produce a change of colour, or, if any change was produced, it ſoon diſappeared again, while the water was boiling; but as ſoon as I had added gr. 3.5, a permanent change was produced to a reddiſh purple: This quantity therefore muſt, in the next

 place,

place, be deducted from the gr. 91.68, and thus we have gr. 88.18, as the quantity of the diluted vitriolic acid which was employed solely in saturating the alkali of the water. But from the essays I had made of the power of this diluted acid in saturating alkalis, it is evident that this quantity of it was sufficient for saturating gr. 0.514 of the pure or caustic fossil alkali, or gr. 0.857 of that which is saturated with air and evaporated to dryness, or about gr. 2.38 of that which is saturated with air and in form of transparent crystals.

The next step was to make a similar experiment to determine the proportion of alkali in the Geyzer water; but here I found it necessary to change a little the mode of ascertaining the point of saturation.

The water of Geyzer, by means of the sulphureous gas, which it contained in greater quantity than the other, and perhaps also by means of some of the other ingredients which it contained, and which gave it a light yellowish colour, produced such a change in the colour of litmus, that it could not be employed, as in the last experiment, by mixing it with the acidulated water and boiling them together; the purple of the litmus was changed to an orange, which could not be made to return to blue or purple, although I added a quantity of alkali, which rendered the liquor very evidently alkaline, when it was examined by other trials. I therefore had recourse to the common method, which I had formerly practised in many other experiments of a similar nature, I mean the use of linen rags, or bits of cambric, which had been tinged with an infusion of litmus. A little bit of these, when touched with a liquor that is in the smallest degree acid or alkaline, has its colour changed from the purple to red or blue. This method is, next after the one employed in the last experiment, the most nice that I know; provided that, in having recourse to it, we remember what was remarked in the former experiment, that the litmus colour is affected by acids in general much more easily than by alkalis; and

and that, though a liquor contain a ſmall quantity of alkali, if this be ſaturated and ſuperſaturated with fixed air, the firſt effect of ſuch liquor upon the ſtained paper will be to change it towards a red. This tint of colour, however, being produced by the ſuperfluous aerial acid, is made to diſappear, by drying the bit of cambric. The colour of it, while drying, will quickly change from the red to purple, and from that to blue, in conſequence of the evaporation of the ſuperſaturating air. Being appriſed of this particular, I firſt made ſome preparatory experiments, with gr. 1000, and alſo with gr. 10,000 of the Geyzer water, and afterwards a more ſatisfactory one with gr. 10,000 of the ſame, in the following manner:

To gr. 10,000 of the Geyzer water, I added gr. 400, accurately weighed, of the largely diluted vitriolic acid, and began ſoon after to evaporate the water, by boiling it gently in a thin bottomed glaſs. The above quantity of acid I knew to be conſiderably more than what was ſufficient for ſaturating the alkali.

The water was boiled until it was reduced to a quantity little exceeding gr. 3000. I then added gr. 84.5 of the dilute ſolution of ſalt of tartar, and boiled the water again gently until it was reduced to gr. 2000. In weighing ſuch ſmall quantities of acid or alkaline liquors as were added to the water in theſe experiments, it is eaſy to adjuſt the weight with the greateſt preciſion, by dipping the end of a ſlender glaſs rod, or of a pointed ſlip of paper, into the fluid. By theſe means, we can take up a quantity of it, as ſmall as we pleaſe; and this method I likewiſe uſed, when I meant to add theſe fluids gradually, and by very ſmall quantities at a time, to any mixture. The end of a ſlender glaſs rod was dipped into them, and afterwards transferred into the mixture.

When I now examined the above boiled water, by means of the tinctured paper or linen rag, I found it reduced to the exact degree of ſaturation which I deſired; that is to ſay, it ſcarcely

 produced

produced a change in the litmus colour, or if any change was produced, it was only a vergency towards the red, which was ſcarcely perceptible; and when the ſtate of ſaturation was varied from this point, by an addition of 3 grains of the largely diluted vitriolic acid, or by an equivalent quantity of the alkaline ſolution, the tint of the colour was remarkably changed towards the red or towards the blue. Suppoſing therefore the above ſtate of ſaturation exact, and I believe it to be the moſt exact that could be depended on, the quantity of largely diluted vitriolic acid, employed in ſaturating the foſſil alkali of the water, was gr. 163.4; for the whole quantity added was gr. 400, and the ſalt of tartar of the gr. 84.5, of the dilute ſolution had required gr. 236.6 for its ſaturation. It follows, therefore, from the eſſays I had made, of the power of this diluted acid in ſaturating the pure or cauſtic foſſil alkali, that the unſaturated quantity of this alkali, contained in the gr. 10,000 of the water, was gr. 0.952, which is equal to gr. 1.587 of the ſame alkali combined with air and evaporated to dryneſs, or gr. 4.409 of the ſame in a cryſtalized ſtate.

The reaſon for boiling theſe waters, with the quantities of acid which I had added to them, in theſe laſt experiments, is ſufficiently obvious. The abundance of acid was meant to inſure the complete ſaturation of the whole of the alkali, and ſeparation of it from the ſiliceous earth; and the boiling promoted the ſame purpoſe, both by means of the heat which was applied, and alſo by bringing the acid and alkaline particles the nearer to one another, while the water evaporated.

A doubt may however poſſibly ariſe in the minds of ſome of my readers, whether this boiling of the water might not be attended with the diſſipation of ſome part of the ſuperfluous acid, which was not neutralized by the alkali of the water; and if any part of the acid was diſſipated, the concluſions concerning the quantity of the alkali would be neceſſarily erroneous.

To

To remove this ſcruple, I took gr. 10,000 of diſtilled water, and added gr. 112 of the diluted acid. This mixture was then boiled down, in the ſame manner as the Iceland water; that is to ſay, in a glaſs which had an oval or nearly globular body, about 5 inches deep, with a neck as long, and half an inch wide. This glaſs was placed in a ſhallow ſand-heat, the bottom of which was a flat iron plate. The boiling was continued until three fourths of the water were evaporated, and then, removing it from the fire, I added gr. 40 of the dilute ſolution of ſalt of tartar. This neutralized it exactly, and ſhewed that no part of the acid had been diſſipated in boiling; and it continued to ſhew the ſigns of ſufficiently exact ſaturation, after I had evaporated it further to the weight of one ounce, in which ſtate, any ſuperfluous alkali, by being leſs diluted, would have been more eaſily diſcernible.

Experiments to determine the nature and quantity of the earthy matter.

Having thus determined the quantity of unſaturated alkali in theſe Iceland waters, my attention was next turned to the earthy matter. A ſmall part of this earthy matter came into view in the boiled and neutralized portions of theſe waters with which I had made the above deſcribed experiments. The neutralized liquors were a little muddy, and depoſited ſlowly a ſmall quantity of ſediment, which collected itſelf cloſely to the bottom of the glaſs, and adhered to it ſlightly. This ſediment, in the *Rykum* water, was deeply tinged with the colouring matter of the litmus; in the *Geyzer* water, it had a brown tinge, and there was a little more of it than in the other. I collected theſe ſediments, by firſt decanting the greater part of the liquor from them, and afterwards filtrating the reſt in a ſmall filtre, in which the ſediment was waſhed, by paſſing diſtilled

water

water through it ſeveral times. Being then dried on the filtrating paper, it contracted greatly, and was divided by fiſſures into a great number of ſmall parts, as would have happened to fine clay, had the ſame quantity of it been dried on paper in a ſimilar manner; and when it was ſeparated from the paper, and further examined, it ſhewed the qualities of an argillaceous earth, combined with a ſmall quantity of colouring matter. This appeared by the following experiments:

1. I PUT ſome of it, which I had procured in different experiments, into a platina ſpoon, and made it red hot. While heating, it firſt became black, then underwent a ſlight inflammation, and afterwards became white, without changing its external form, being only a little contracted in its ſize, and diminiſhed in its weight.

2. To another ſmall maſs of it, laid on a plate of glaſs, I added a drop of aquafortis, which neither effervefced with it, nor diſſolved it, but only changed the colour to a paler red.

3. ANOTHER ſmall portion, which had been gently calcined, was well mixed with an equal weight of the aerated foſſil alkali, and then expoſed to a ſtrong heat in the platina ſpoon. The alkali was quickly melted and became cauſtic; but I could not by its means bring the earth into fuſion or if any was diſſolved by the melted alkali, it was only a very ſmall portion, not perceptible by the appearances.

4. NOR did I ſucceed much better, when I tried to melt or diſſolve it by means of borax, heated on charcoal with the blowpipe. A little maſs of this earth continued undiſſolved in the melted borax, and without any appearance of effervefcing with it, until I was tired of the experiment.

THIS earth therefore cannot be any other than the argillaceous. Had it been the ſiliceous, it would have been melted with the alkali into a tranſparent glaſs, which happened eaſily with different ſpecimens of pure ſiliceous earth, ſubjected to the ſame trial; and had it been any of the alkaline earths, the borax would

would have diſſolved it quickly with efferveſcence. The quantity of this earthy ſediment, from either of theſe neutralized waters, was very ſmall. From gr. 10,000 of *Rykum* water, I could only collect a quantity, which, after receiving an obſcure red heat, weighed the twentieth part of a grain; from the ſame quantity of the *Geyzer* water, I got about 38 or 39 hundredths of a grain.

In one of my experiments with *Rykum* water, I got this argillaceous earth from it by another proceſs. I had a dry extract, obtained by evaporating gr. 20,000 of this water, and which weighed gr. 16½. Thirty grains of aquafortis were added to it. This aquafortis was made up of equal parts of the ſtrongeſt nitrous acid and water. The extract was digeſted with it ſix or eight hours, and then diſtilled water being added, the mixture was filtrated in a ſmall filtre, to ſeparate the clear acid liquor from the undiſſolved matter. The filtrated acid liquor was then ſaturated, and a little more than ſaturated, with a pure aerated alkaline ſalt, and the ſaturated mixture was heated to a boiling heat. It became muddy, and depoſited a ſmall quantity of ſediment like mucilage, which being collected by filtration, and dried, and heated to an obſcure red heat, weighed juſt one tenth part of a grain, and had the qualities above enumerated, which ſhewed that it was an argillaceous earth. In another experiment, I digeſted an extract of *Geyzer* water with ſtrong vitriolic acid, and thus got from it a ſimilar earth; but the quantity of it was very little greater than that which I had got by ſubſidence from the neutralized and boiled part of the ſame water, in the experiments above deſcribed.

The greater part, however, of the earthy matter had not yet made its appearance; I mean the ſiliceous earth. It ſtill remained in a ſtate of perfect diſſolution in the neutralized and boiled mixtures above deſcribed, ſome part of which had actually paſſed through filtrating paper; and I learned, by other trials, that the whole of theſe neutralized mixtures might have been

been filtrated, without danger of ſeparating any part of the ſiliceous earth from the water by that operation. This is a conſequence of the ſingular nature of the ſiliceous earth, ſeveral properties of which, hitherto unnoticed, or not exactly deſcribed, I became acquainted with in the courſe of theſe experiments.

We have no experience of the poſſibility of diſſolving this earth in its concrete ſtate by water alone; but if it be diſſolved in water by means of an alkaline ſalt, although we afterwards completely ſaturate the alkali with an acid, the earth thus ſeparated, provided there is enough of water, will not ſubſide; it will remain diſſolved; the mixture will appear perfectly tranſparent, and will paſs through the filtre without the ſmalleſt difficulty. To gr. 1000 of the *Geyzer* water, I added more than enough of acid to ſaturate the alkali. I then boiled the mixture a little while, until a ſmall part of it only was evaporated, and I ſet it aſide in a quiet place. I know it contains a little more than half a grain of ſiliceous earth; but after ſtanding twelve months, there is not the ſmalleſt appearance of ſeparation, the mixture is ſtill perfectly tranſparent and fluid in every part of it, though it be decidedly acid; and I know, that had it been boiled down to a proper degree, a ſeparation of the ſiliceous earth would have happened in a ſhort time. I learned this by another experiment with *Rykum* water. To gr. 1000 of this water, I added a quantity of acid more than ſufficient for ſaturating the alkali. The water was then boiled till it weighed only 138 grains, and it was ſet up in my cloſet to remain undiſturbed. In about eight days, the tranſparency of it was a little diminiſhed, and afterwards there was a very ſlow ſubſidence of the matter which had produced this effect. It formed gradually, at tht bottom, a ſtratum of ſome thickneſs, which was a little leſs tranſparent than the clear water above, and was thereby diſtinguiſhable from it. After a week or two more, I poured off the clear water entirely, without diſturbing the ſediment, which was in fact a tender jelly, adhering to the bottom of

of the glafs, and the upper furface of which was level and fmooth. I knew the quantity of filiceous earth contained in it; and comparing this with the weight of the water, when reduced by boiling to gr. 158, I found the proportion of the earth to that quantity of water to be as 2.68 to 1000; and having weighed the jelly by itfelf, the proportion of filiceous earth to the water in it, fuppofing that it contained the whole of the earth, was 10.88 to 1000. In another experiment, in which a fimilar mixture had been lefs boiled, and in which the filiceous earth bore to the water the proportion of 2.1 or 2.2 to 1000, I found a foft jelly formed at the end of forty days. And in another, in which the boiling and evaporation was continued until the jelly began to be formed in the upper part of the liquor while it was boiling, I found the proportion of the filiceous earth to the remaining water to be nearly as 3.75 to 1000.

After this jelly is once formed, I never could bring it again into a ftate of diffolution by water alone, whatever quantity of this laft was added.

It appears therefore by thefe experiments, that when filiceous earth, united with an alkali, is diffolved in 1000 times, or in more than 500 times its weight of water, it will not feparate or fubfide from that quantity of water, although we feparate or difengage the alkali from it. The particles of it, placed at that diftance, do not act on one another by their attraction of cohefion or concretion. It is neceffary, in order to enable them to attract one another, that they be brought nearer, by diminifhing the quantity of the water, until it be lefs than 500 times the weight of the earth. When this is done they will enter into a ftate of cohefion, fooner or later, according as the water has been more or lefs diminifhed. But this ftate of cohefion into which they firft enter, is alfo remarkable. The force of it is exceedingly weak, and it takes place while the particles of the earth are ftill at a confiderable diftance from one another. They therefore retain and entangle among them a large quan-

tity of water, amounting to about 100 times their own weight, and perhaps more than 200 times their bulk, with which they form a confiftent jelly, almoft perfectly tranfparent.

It may be afked here, what prevents the particles of this earth from approaching one another more nearly, and entering into a ftate of ftronger cohefion? We may, if we pleafe, imagine that they retain round each of them, by chemical attraction, a quantity of water, which forms a little fphere or polyhædron, with the particle of earth in its centre. Thus, each particle is prevented from coming within a fmaller diftance of the other particles around it, than the diameter of that fphere; but let the water of thefe fpherules be diminifhed in quantity by evaporation, in confequence of heat, or the attraction of the air, the particles of the earth will immediately enter into a ftate of clofer connection and ftronger cohefion, of which we have examples in the exceffive contraction of the jelly, while it is dried up into crufts, and in thofe circles of thin incruftation which were formed on the fides of the glafs-veffels, while the waters were evaporated to drynefs in the firft experiment, the particles of which were fo ftrongly united to one another, and to the furface of the glafs, that they coft me much trouble and time to fcrape them off with a knife.

When fuch a concretion is once formed of this earth, and afterwards receives frequent additions of the fame matter, which, infinuating itfelf into the pores of the concretion, is fixed there, and encreafes its denfity and folidity, the mafs may in time acquire a furprifing degree of hardnefs. The petrifactions of *Geyzer* are undoubtedly formed in this manner, and fome of them are fo denfe and hard that they are fcarcely diftinguifhable from agate or calcedony.

After making thefe obfervations on the nature of the filiceous earth, the proper method for extracting it from the above boiled and neutralized portions of thefe waters was fufficiently obvious. I feparately evaporated them to drynefs with a gentle heat

heat in two china cups, carefully waſhing every drop of them from the glaſſes into the cups with diſtilled water, and then taking out the dry extracts out of the cups, I put them ſeparately into ſmall filtrating papers, and paſſed diſtilled water through them repeatedly, until all the ſaline matter was waſhed away. The papers being then carefully dried, I found the earth in them exceedingly ſpungy, fine and tender. The quantity of it, obtained in this ſtate from the gr. 10,000 of *Rykum* water, was gr. 3.8, which were reduced by the action of an obſcure red heat to gr. 3.73 nearly. From the ſame quantity of the *Geyzer* water, I got gr. 6.8 of the dried earth, which, by a ſimilar heat, were reduced to gr. 5.4, and theſe gr. 5.4 being digeſted with aquafortis, and again waſhed with diſtilled water, to extract any argillaceous earth that might remain in them, I obtained only gr. 0.1 of this earth, which added to the quantity obtained before, makes up gr. 0.48 of the argillaceous earth, from the gr. 10,000 of *Geyzer* water, the remaining gr. 5.3 being pure ſiliceous earth. Some of it was melted into a perfect glaſs in the platina ſpoon, with one half of its weight of aerated foſſil alkali evaporated to dryneſs. The diminution of the weight of the dried earth, from gr. 6.8 to gr. 5.4, which happened when it was gently calcined, proceeded from ſome inflammable matter, which adhered to it at firſt, and gave it a yellowiſh colour. This colour changed firſt to black, and afterwards to a pure white, during the calcination. The inflammable colouring matter might have been received in part from the veſſels in which the water was brought, ſome of which were tainted with the odour of ſpirituous liquors, or the water might have got a part of it from ſubterranean ſtrata of clay, or other earths containing inflammable matter.

Experiments to learn the quantity of the neutral ſalts.

The only ingredients of theſe waters, the quantity of which had not yet been examined, were the neutral ſalts. The preliminary experiments, and the appearances obſerved in the watery ſolutions of the extracts of theſe waters, gave me reaſon to be ſatisfied, that theſe neutral ſalts were partly common ſalt and partly Glauber's ſalt. To aſcertain the quantities of them, I made the following experiments: I had ſome common ſalt, which had been refined by a ſecond cryſtalization, and was in ſolid dry and large cryſtals. Of this I weighed ten grains exactly, which were diſſolved in about half a pound of diſtilled water. I then added a ſolution of ſilver, which contained a little ſuperfluous acid. The ſilver was precipitated in the form of luna cornea or argentum muriatum; and I took care to add rather more than the quantity which the ten grains of common ſalt could precipitate. The luna cornea, after complete ſubſidence, and decantation of the ſaline water from it, was carefully collected on a ſmall filtre, and well waſhed with diſtilled water, and thoroughly dried and weighed. I thus learned, that 100 parts of common ſalt are ſufficient to give 235 of luna cornea. This enabled me to learn, by ſimilar experiments, how much common ſalt is contained in the Iceland waters, and I found that the quantity contained in 10,000 grains of *Rykum* water was gr. 2.90, and in the ſame quantity of the *Geyzer* water, I found there was gr. 2.46 of common ſalt. Some of my readers may perhaps be inclined to ſuſpect, that the Glauber's ſalt contained in the Iceland waters, might, by means of its vitriolic acid, cotribute to the precipitation of a part of the ſilver; but experiments have ſatisfied me, that a ſmall quantity of vitriolic acid, or of any vitriolic ſalt, diſſolved in a large quantity of water,

water, does not precipitate ſilver *; and to prevent any part of the ſilver being precipitated by the alkali of the water. I added of purified aquafortis, more than enough to ſaturate the alkali, before I added the ſolution of ſilver.

Another ſet of experiments, on the ſame plan, but made with Glauber's ſalt and the ſolution of barytes, in place of common ſalt and ſolution of ſilver, enabled me to aſcertain with equal exactneſs the quantity of Glauber's ſalt contained in theſe waters. I firſt learned that if pure Glauber's ſalt be perfectly exſiccated, by evaporating the water that is in its cryſtals, 10 parts of this exſiccated ſalt are ſufficient to precipitate as much barytes, from its ſolution in muriatic acid, as will form 17 of barytes vitriolica. This fact being aſcertained, I added ſome of the diſſolved barytes, to ſeparate portions of the Iceland waters, ſo long as any muddineſs and precipitation was produced; and I carefully collected, waſhed, dried and weighed the precipitates. I thus learned, that the water of Rykum contains in gr. 10,000 of it, as much Glauber's ſalt as would give gr. 1.28 of exſiccated Glauber's ſalt, and the water of Geyzer as much as would give gr. 1.46 †.

In making theſe laſt experiments alſo, I added ſome purified nitrical acid to the Iceland waters, to prevent any precipitation of the barytes which might have been occaſioned by the alkali of the water.

In reviewing the experiments I have now deſcribed, if we neglect the ſmall quantity of ſulphureous gas, the contents of theſe waters will appear as follows:

In

* See the appendix to this paper.

† The method by which theſe ſmall quantities of ſediments and precipitates were collected and weighed, is explained in the appendix to this paper.

In gr. 10,000 of *Rykum* water there are,

Of cauftic foffil alkali,	-	gr. 0.51
Argillaceous earth,	- -	0.05
Siliceous earth,	- -	3.73
Common falt,	- -	2.90
Glauber's falt when exficcated,	-	1.28
	Total,	8.47

In gr. 10,000 of *Geyzer* water,

Cauftic foffil alkali,	-	gr. 0.95
Argillaceous earth,	- -	0.48
Siliceous earth,	- -	5.40
Common falt,	-	2.46
Glauber's falt exficcated,	-	1.46
	Total,	10.75

THESE quantities of the ingredients, as determined by the above experiments, exceed the quantities of dry extract which I obtained by evaporation. Gr. 10,000 of the *Rykum* water gave by evaporation gr. 8.25 of dry extract, and the fame quantity of *Geyzer* gave gr. 10 only. This difference, however, can eafily be accounted for. It is well known that common falt, and other falts, fuffer fome lofs by evaporation, when watery folutions of them are evaporated to drynefs ; and the odour which was perceived in the end of the evaporation of thefe waters, made me fufpect that a little of the falt might have been loft. There was therefore no reafon to expect that the refult of the analytical experiments would tally exactly with the extract by evaporation. I was rather furprifed and pleafed to find that they

they came ſo near, and am perfectly ſatisfied that this analyſis is as complete and exact as it was in my power to make it, with that quantity of water which I got for this purpoſe.

THE proportions of the above enumerated ingredients to the water in which they are contained, ſhew the quantities of them contained in an Engliſh gallon of 231 cubical inches, or 58,484 grains, which are as follows:

In an Engliſh gallon of *Rykum* water:

Cauſtic foſſil alkali, -	gr. 3.
Argillaceous earth, - -	0.29
Siliceous earth, - - -	21.83
Common ſalt, - -	16.96
Glauber's ſalt exſiccated, -	7.53

In an Engliſh gallon of *Geyzer* water:

Cauſtic foſſil alkali, -	gr. 5.56
Argillaceous earth, - -	2.80
Siliceous earth, - - -	31.58
Common ſalt, - -	14.42
Glauber's ſalt exſiccated, -	8.57

HAVING now ſtated the ſeveral ingredients of theſe hot ſprings. and their proportions, the principal queſtions which remain to be conſidered, are, How is the ſiliceous earth diſſolved in them, or combined with the water? Has hot water alone a power to diſſolve this earth, or was it diſſolved by the medium of the alkali only? And how came the ſalts which we find in theſe waters and the ſulphureous gas to be combined with them? As all attempts to anſwer theſe queſtions muſt be conjectural, different opinions will be formed concerning them; and

and I may offer what I have imagined, without its being thought neceſſary to make an apology. Profeſſor BERGMAN conſidered the ſiliceous earth in theſe waters as diſſolved by the power of the hot water alone; and ſuppoſed, that water, aided by exceſſive heat, became a ſolvent of this ſpecies of earth. He formed this opinion, however, under diſadvantageous circumſtances, and from a partial view of the ſubject. He only knew that this earth is actually diſſolved in theſe waters, and depoſited by them, and that they ſpring out of the ground of a full boiling heat, with appearances of their having been hotter below. He did not know what other ingredients they contained along with the earth. As we now know they contain an alkali, which is a powerful medium for combining this earth with water, I do not think that the power of water alone to diſſolve it can be admitted, until it is proved by direct experiments; and I am not of opinion that theſe will ſucceed. I am perſuaded that both the ſiliceous and the argillaceous earth have been diſſolved by the medium of the alkali, but at the ſame time that the violent and long continued heat contributed greatly, and was even neceſſary to this diſſolution. The proportion of the cauſtic alkali to the earthy matter in one of theſe waters, is as $13\frac{1}{2}$ to 100; in the other it is 16 to 100. When we form artificial compounds of ſiliceous earth and alkali in theſe proportions, we find that cold water has no power to diſſolve them, though boiling water, by length of time, would certainly act on them. Even cold water, or the humidity of the earth, is well known to penetrate the hardeſt glaſs that is expoſed to it for years or for ages; and I have had the experience of the power of hot water to act on glaſs, when I have diſtilled water in the ſame glaſs retorts a great number of times, or evaporated water often in other glaſs-veſſels. Their internal ſurface was evidently affected by the continued action of the hot water. Its firſt effect is to ſoften thin laminæ at the ſurface of the glaſs, and to make them ſeparate from that ſurface, in conſequence probably

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of their being ſwelled and extended by the water penetrating into them; and by a longer action of the water, there is no doubt that they, or ſome part of them, are completely diſſolved.

Those who may have objections againſt admitting, that a boiling heat, and great length of time, are ſufficient aids to enable water to diſſolve a compound of the ſiliceous earth with ſuch a ſmall proportion of alkali, may imagine this earth to have been at firſt combined with a larger proportion of alkali than that we now find combined with it, and that after it was diſſolved in the water, a part of this alkali was neutralized by acid vapours, or acid ſubſtances, which the water found in its way towards the ſurface.

On the whole, however, the ſuppoſition which appears to me the moſt probable is, that common ſalt and Glauber's ſalt, conveyed by ſea-water, or contained in foſſils formed from ſea-plants, have been applied, under the influence of a violent heat, to ſome of the numerous earthy and ſtony ſtrata which contain mixtures of ſiliceous and argillaceous earth; that thoſe ſalts have been in part decompounded, by the attraction of theſe earths for the alkali of the neutral ſalt, part of the acid has been diſſipated, or changed into ſulphur and ſulphureous gas, by the action on it at the ſame time of inflammable matter, which we know to be preſent in many of the ſtrata; and that the compound of alkali and earthy matter has afterwards been long expoſed, and continues expoſed, to the action of the hot water. By ſuch a ſuppoſition, we can imagine how the ſeveral ingredients of theſe hot ſprings became diſſolved in them; and this ſuppoſition appears the more probable, when we attend to the accurate obſervations of Mr Stanley, on the nature of the country, and ſtate of the ſoil, in which theſe two hot ſprings are found. The rocks and mountains, which are at a ſmall diſtance, or in the immediate vicinity of each of them, are formed chiefly of different kinds of lava. The lower country and ſoil

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at the foot of theſe, and in which the ſprings riſe, is compoſed of fragments of theſe lavas; but in digging into this ſoil or rubbiſh to a ſmall depth only, theſe fragments are every where found reſolving, or reſolved, into a matter like clay. At a certain depth, the fragments of ſome ſpecies of lava remain entire and hard, while the reſt are changed. At a greater depth, even theſe more durable kinds are found to have undergone the ſame change with the reſt. As this change is produced by the conſtant action of the hot water, it probably depends on a gradual diſſolution and extraction from theſe lavas of ſome of their ingredients, which are diſſolvable in water; and thoſe which we have actually found in the water may have been ſome of theſe. But I offer all this as a conjecture only, which every perſon who does not like it is at liberty to reject.

I SHALL venture further to offer another conjecture, which ſome particulars I learned by Mr STANLEY's voyage to Iceland have ſuggeſted to my mind. It is concerning the origin of the pure ſulphur, which is found at the ſurface of the earth, in the neighbourhood of many volcanos in different parts of the world. In Iceland, there are places in which ſulphur is thus found in very great quantity, covering the ſurface of the ground, and that of the ſtones and rocks, in form of a thick cruſt, and conſtituting what are called ſulphur banks. This was ſeen in Iceland in particular ſpots, in which there were very ſtrong ſulphureous hot ſprings, which emitted ſuch a quantity of ſulphureous or hepatic gas, that the air all around was infected with it to the higheſt degree, and the water itſelf was muddy and black, and conſtantly boiling. Now, as we know, that vital air has the power to decompound this gas, and to make it depoſit the ſulphur which it contains, I am of opinion, that the ſulphur which appeared in ſuch quantity in the vicinity of theſe ſprings, had been depoſited and accumulated in this manner from the hepatic gas, which theſe ſtrongly ſulphureous ſprings have emitted during a great length of time.

A. P.

A P P E N D I X.

In order to ſhew, that ſuch a ſmall proportion of a vitriolic ſalt as is contained in the Iceland waters, has not the power to precipitate ſilver, I diſſolved gr. 0.3 of exſiccated Glauber's ſalt, in gr. 2000 of diſtilled water, which thus contained a proportion of Glauber's ſalt rather greater than that contained in the Iceland waters. I then added five drops of purified aquafortis, and five drops of the ſolution of ſilver. The mixture remained tranſparent ſeveral days. I afterwards added gr. 0.7 more of the exſiccated Glauber's ſalt, without diminiſhing in the leaſt the tranſparency of the mixture. After a few days more, I added gr. 9 of the exſiccated Glauber's ſalt. This produced a diminution of tranſparency, and the ſediment ſubſided in a few days more. This ſediment being carefully collected and dried, weighed gr. 0.3; but the clear liquor which had been filtrated from it, ſtill retained the greater part of the ſilver. I therefore added to it ſome pure common ſalt, which precipitated all the reſt of the ſilver, and this laſt precipitate, being alſo collected and dried, weighed juſt one grain.

When I examined theſe two precipitates by means of the blowpipe, their qualities appeared to me ſo much the ſame, that I ſuſpect the firſt was produced by a ſmall quantity of common ſalt, contained imperceptibly in the Glauber's ſalt. If there were 12 or 13 parts of common ſalt in 1000 of the Glauber's ſalt, they were enough to produce the above quantity of the firſt precipitate; and as Glauber's ſalt is prepared from common ſalt, we can eaſily underſtand how a ſmall quantity of the common ſalt may remain in it.

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For the ſake of thoſe who may have occaſion to undertake ſuch chemical enquiries as that deſcribed in the above paper, I ſhall here mention the method by which I collected and weighed the ſmall quantities of ſediments or precipitates, which I obtained in ſome of theſe experiments. In moſt caſes, the turbid liquor was left at reſt in a cylindrical glaſs, until the ſediment was ſo well collected at the bottom, that the greateſt part of the liquor was quite clear, and then this clear part was carefully decanted; the reſt, which could not be decanted without diſturbing the ſediment, was ſhaken, and poured gradually into a ſmall filtre, that the ſediment might be collected upon the filtre, and afterwards waſhed on it, by paſſing diſtilled water through it repeatedly. And this part of the proceſs was much facilitated by the preparation of the filtre, and ſome other little manœuvres. When, for example, I uſed for my filtre a piece of paper about four inches in diameter, I began by folding it, and giving it the proper form; then I ſpread it open again, and warming it, I applied melted tallow or bees wax to the margin of it all round, until it was ſoaked therewith to the breadth of a full inch from the margin inwards, the middle part of it being carefully preſerved clean. As ſoon as this was done, and while it was yet a little warm, it was folded again into the proper form of a filtre, and retained in that ſtate until it was cold. On a filtre prepared in this manner, it is much more eaſy to collect a ſediment together, and to waſh it clean, than on an ordinary filtre. In the firſt place, no part of the ſediment adheres to or is depoſited on that part of the paper which was ſoaked with tallow. The whole is collected on the clean part of the paper, and after it is collected there, I condenſe it into the centre as much as poſſible, by dropping the diſtilled water on the margin of that clean part all round, or a little above that margin, by which practice the ſcattered particles of the ſediment are waſhed down into the bottom. Sometimes I apply what may be called a capillary jet of the diſtilled water, di-

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rected with force to thofe parts of the fcattered fediment which are more difficultly moved. Having thus condenfed the fediment as much as poffible, the filtre is left in a cool place to dry. When it is perfectly or nearly dry, I fpread it flat on a table, and cut away all that part which was foaked with tallow, and and alfo thofe parts of the clean paper to which the fediment does not adhere. The reft, with the fediment on it, is then well dried before a fire, and weighed, and the weight of it marked down; and, laftly, in order to know how much of this weight is made up by the paper, I take care, before I prepare the filtre, to chufe another piece of the filtrating paper, equal in thicknefs to the one of which the filtre is made. This equality of thicknefs is judged of by holding the two pieces between the eye and the light; or, for greater fecurity, bits of the two pieces may be cut off, exactly fimilar and equal in form and fize, and their weight compared, and allowance may afterwards be made for their difference of weight, if there be a difference. After weighing the bit of paper with the fediment on it, a proper bit of the referved paper is laid flat on a fmooth table or plate of glafs, and the paper on which the fediment had been collected is laid over it, with the clean fide undermoft; then a bit of card, fomewhat lefs, but nearly of the fame form, is preffed down on both the papers, and, with a pair of fharp pointed fciffars, or a pen-knife, the undermoft paper is cut exactly to the fame fhape and fize as the uppermoft, and is afterwards weighed. The weight of it being deducted from that of the former, we thus learn the weight of the fediment, with a greater degree of exactnefs, and with lefs trouble, than by any other method which I have been able to contrive. To complete this article, I beg leave further to add, that the moft ready and convenient way to foak the margin of the filtrating paper with tallow or wax, is to hold it above a lighted candle, at a proper diftance for warming it a little, and then melting the end of another candle, apply it immediately to the warmed

warmed paper, and repeat this, until the paper is prepared as above directed. The prominent part of the wick of the candle, which is thus melted, becomes a ſort of pencil, which holds the melted tallow or wax, and facilitates the application of it, and the wick of a tallow candle, on account of its being thicker, is fitter for this purpoſe than the wick of a wax one.

The laſt remark on theſe experiments I ſhall now make is, that, in the trials with the ſolution of barytes, the barytes vitriolica was formed in particles ſo very minute, that they did not all remain at firſt upon the filtre. Some of them paſſed through it, and made the filtrated liquor a little muddy; but by making this muddy liquor paſs through the filtre a ſecond time, it was made quite clear, the whole of the ſediment being thus collected on the filtre.

V.

V. *An* ACCOUNT *of the* HOT SPRINGS *near Rykum in Iceland: In a Letter to Dr* BLACK *from* JOHN THOMAS STANLEY, *Esq;* M. P. F. S. A. A. LOND. and F. R. S. EDIN.

[*Read Nov.* 7. 1791.]

DEAR SIR, *Alderley, August* 15. 1791.

I HAVE been prevented hitherto, by various occupations, from acquitting myfelf of a promife you received from me, (I am afhamed to think how long a time fince), that I would fend you an account of the hot fprings in Iceland, from whence the water was brought which you have lately analyfed. I have trufted you would excufe a delay not altogether voluntary. It will be now my endeavour to gratify your curiofity as far as I am able; and to acquaint you with every particular, as well concerning the fprings as the country near them, which I think you may find in the leaft interefting.

WE faw many fprings in the courfe of our journey befides thofe I am going to defcribe; nor indeed are they confined to the part of the ifland we vifited, but break out in every divifion of it. For a general account of the moft remarkable, I refer you to a letter, written by Dr VAN TROIL, (the prefent Archbifhop of Upfal), to Profeffor BERGMAN, publifhed with fome others concerning Iceland in the year 1777.

THE defcriptions given by this author are fo accurate, that it will not be in my power to give you much new information.

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I muſt, in a great meaſure, repeat what he has ſaid. It may be ſatisfactory, however, to you to have his relations corroborated; and ſome further details, with an account of the changes which, in a few inſtances, have taken place ſince he viſited theſe particular ſprings in 1772, may contribute to explain their hiſtory, and the cauſe of their very ſingular appearances.

You received two kinds of water, one from a ſpring near a farm called Rykum, and the other from the fountain known by the name of the Geyzer, the moſt remarkable in the iſland. It riſes near the farm of Haukadal, about forty miles from Rykum. They are both ſituated in the S. W. diviſion of the iſland.

I SHALL begin with a deſcription of the country and the ſprings near Rykum, and of the firſt view we had of them in our way from Rykavick to Mount Hecla. Rykum is ſituated in a valley, which, on account of its fertility, and the ſtrong contraſt it made with the dreary ſcenes we had paſſed ſince our laſt ſtation, appeared to us with great advantage while we approached it. We had traverſed a country, ſeven or eight miles in breadth, entirely overſpread with lava, and other volcanic matter. It was ſurrounded with hills, not ſufficiently high to be majeſtic, and too rugged and too barren to be pleaſing. We were told by our guides, that, on a clear day, the ſummits of Hecla might be ſeen above thoſe which were immediately before us; but heavy and lowering clouds, which threatened us inceſſantly with a ſtorm, concealed every diſtant object from our ſight.

WE ſaw many diſtricts in Iceland covered with lava; but I do not recollect one ſo uncouth and deſolate as this. No vegetation was to be ſeen but that of a few ſtunted buſhes of willow and birch, growing between the crevices and hollows of the lava, into which the wind had drifted ſufficient ſoil for them to take root. We could diſcover no mount or crater from whence

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we could conjecture, with any degree of probability, the lava to have iſſued. It extended round us like a ſea; and it had burſt perhaps from ſome part of the country it now covered, while the fire to which it owed its origin, had eſcaped with its ſhowers of cinders and aſhes, from ſome other orifice, and had formed one of the numberleſs cones we could diſcover amidſt the neighbouring hills.

The unpleaſantneſs of our ride over this country was increaſed by the continual danger to which we were expoſed of our horſes falling. The road was no other than what the few travellers of the country, as they paſſed from their farms to Rykavick, had tracked over the lava where it was leaſt rough; but even this was interrupted by many breaks and crevices, formed by the cooling of the matter and the contraction of its parts.

To this uncomfortable ſcene ſucceeded the view of a rich valley, opening into an extenſive green plain bounded by the ſea. A river was ſeen winding between ſeveral fertile meadows; and beyond theſe, the valley was terminated by a range of high and bold rocks. But our attention was chiefly attracted by the clouds of ſteam, which aſcended in various parts of the valley from the hot ſprings, and by jets of water which, from ſome of them, were inceſſantly darted into the air.

We deſcended into the valley by a road winding over the lava, which, in one place, had flowed from the upper plain into the country below. On each ſide it had ſtopped abruptly, and had thus formed a perpendicular wall, at leaſt ſixty feet high.

We pitched our tents in a pleaſant field, on the ſide of the river, oppoſite to the farm, and not far from it, and at the foot of the hills which bounded the valley. Several fragments of rocks, which had fallen from theſe, lay ſcattered round our ſtation. Theſe were entirely volcanic; ſome of dark blue lava, not unlike baſalte; others of a yellow ſubſtance; and again others of a gray lava, mixed with a great quantity of white

glaſs: But the moſt curious conſiſted of an heterogeneous mixture of various ſubſtances, cemented indiſcriminately together by ſome operation, ſubſequent to their original formation, and ſo ſtrongly, that the rock was broken with difficulty by our hammers. It conſiſted of pieces of black glaſs, (a lava in all probability much vitrified), and large pieces of a cloſe, gray lava, the cavities and pores of which were filled with zeolites finely radiated. Some pieces of black lava, in parts compact, and in other parts ſo porous as to approach nearly to a pumice ſtone, were mixed with the reſt of the maſs. A mixture of theſe ſame ſubſtances, (the lavas, the glaſs and the zeolites), pounded in ſmall grains, filled the ſpaces between the larger pieces, and connected the whole into a ſolid rock. The heat (if heat it was) which had cemented theſe materials, had not been ſtrong enough to reduce any one to a ſtate of fuſion; for the angles of the fragments were as ſharply defined as if newly ſeparated from their reſpective original beds.

The rocks from whence theſe different maſſes have been detached, lay heaped together in ſo disjointed and irregular a manner, that ſome violent convulſion has evidently taken place among them ſince their firſt formation; but ſimilar appearances of diſorder are to be ſeen in every range of hills in the country. Regular ſtrata are no where to be met with. It appears as if all this part of the iſland, at different periods, had been thrown up from its foundations.

The valley is in this place fertile, and nearly half a mile in breadth. It becomes more narrow towards the north; and it is there rendered barren by heaps of crumbled lava, or other rubbiſh, brought down from the hills by the waters. Theſe have the appearance of artificial mounds, and a great number of ſprings are continually boiling through them. Below the ſurface, a general decompoſition ſeems taking place; for almoſt wherever the ground is turned up, a ſtrong heat is felt, and the looſe earth and ſtones are changing gradually into a clay or bole

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of various colours, and beautifully veined, refembling a variegated jafper. The heat may poffibly proceed from a fermentation of the materials compofing thefe mounds; but more probably (I fhould conjecture) from the fprings and fteam forced up through them. The fprings muft have acquired their heat at fome greater depth, from fome conftant, fteady caufe, (however difficult to explain), adequate to the length of time they have been known to exift, with the fame unvaried force and temperature.

SPRINGS do not boil on or near thefe banks only. They rife in every part of the valley, and within the circumference of a mile and an half, more than an hundred might eafily be counted. Moft of them are very fmall, and may be juft perceived fimmering in the hole from whence the fteam is iffuing. This, trailing on the ground, depofits in fome places a thin coat of fulphur. The proportion varies; for near fome of thefe fmall fprings, fcarce any is perceptible, whilft the channels by which the water efcapes from others, are entirely lined with it for feveral yards. Neither the water, nor the fteam from the larger fprings, ever appear to depofit the fmalleft proportion of fulphur; nor can the fulphureous vapour they contain be difcovered, otherwife than by the tafte of what has been boiled in them for a long time.

MANY fprings boil in great caldrons or bafons, of two, three or four feet diameter. The water in thefe is agitated with a violent ebullition, and vaft clouds of fteam fly off from its furface. Several little ftreams are formed by the water which efcapes from the bafons; and as thefe retain their heat for a confiderable way, no little caution is required to walk among them with fafety.

THE thermometer conftantly rofe in thefe fprings to the 212th degree; and in one fmall opening, from whence a quantity of fteam iffued with great impetuofity, Dr WRIGHT obferved the mercury rife, in two fucceffive trials, to the 213th degree.

I HAVE already ſaid, that the ground, through which many of the ſprings were boiling, was reduced to a clay of various colours. In ſome, the water is quite turbid; and, according to the colour of the clay through which it has paſſed, is red, yellow or gray.

THE ſprings, however, from whence the water overflows in any great quantity, are to appearance perfectly pure. The moſt remarkable of theſe was about fifty or ſixty yards from our ſtation, and was diſtinguiſhed by the people of the neighbourhood, by the name of the little Geyzer. The water of it boiled with a loud and rumbling noiſe in a well of an irregular form, of about ſix feet in its greateſt diameter; from thence it burſt forth into the air, and ſubſided again, nearly every minute. The jets were daſhed into ſpray as they roſe, and were from twenty to thirty feet high. Volumes of ſteam or vapour aſcended with them, and produced a moſt magnificent effect, particularly if the dark hills, which almoſt hung over the fountain, formed a back ground to the picture. The jets are forced in riſing to take an oblique direction, by two or three large ſtones, which lay on the edge of the baſon. Between theſe and the hill, the ground (to a diſtance of eight or nine feet) is remarkably hot, and entirely bare of vegetation. If the earth is ſtirred, a ſteam inſtantly riſes, and in ſome places it was covered with a thin coat of ſulphur, or rather, I ſhould ſay, ſome looſe ſtones only were covered with flakes of it. In one place, there was a ſlight efflorеſcence on the ſurface of the ſoil, which, by the taſte, ſeemed to be alum.

THE ſpray fell towards the valley, and in that direction covered the ground with a thick incruſtation of matter which it depoſited. Cloſe to this, and in one ſpot very near the well itſelf, the graſs grows with great luxuriance.

WHERE the ſoil was heated, it was gradually (as on the mounds) changing into a clay. But it was here more beautiful than in any other place. The colours were more varied and bright,

bright, and the veins were marked with more delicacy. The tranſition likewiſe from one ſubſtance into the other, was more evident and ſatisfactory.

To the depth of a few inches, the ground conſiſted of looſe lavas, broken and pounded together, of blue, red and yellow colours. The blue lava was hardeſt; and ſeveral pieces of it remained firm and unaltered, while the reſt were reduced to a duſt. The colours became brighter as the decompoſition of the ſubſtances advanced, and they were changed at the depth of nine or ten inches into a clay; excepting, however, the pieces of dark blue lava, which ſtill retained ſufficient hardneſs to reſiſt the preſſure of the finger. Round theſe, (which appeared inſulated in the midſt of the red and yellow clay), ſeveral veins or circles were formed of various ſhades and colours. A few inches deeper, theſe alſo became part of the clay, but ſtill appearing diſtinct, by their circles, from the ſurrounding maſs. The whole of this variegated ſubſtance reſted on a thick bed of dark blue clay, which had evidently been formed in the ſame manner from ſome large fragment of blue lava, or ſtratum of it, broken into pieces.

The reſemblance of theſe clays to jaſper is ſo ſtriking to the eye, that I cannot forbear believing their origin to be ſimilar, at leaſt, that ſome circumſtances in the formation of each are the ſame. You will ſay, with reaſon, that the difference, notwithſtanding the apparent ſimilitude, is in reality very wide; that theſe clays, before they can be converted into jaſpers, require to be conſolidated, and impregnated with a conſiderable proportion of ſiliceous earth. It is ſomething, however, to have detected nature in the act of forming, in any ſubſtance, the veins and figures common to marbles and jaſpers. What ſtill remains of the proceſs, after thus much of it has been traced, may not long continue unknown; and in Iceland, probably ſooner than elſewhere, will be diſcovered beds of clay, like this, hardening into ſtone, either by the effect of ſubterraneous heat

or

or preſſure promoting an adheſion of the particles, or by ſome inſinuation of matter (perhaps ſiliceous) into the pores of the maſs.

THERE is another fountain in the valley not much inferior in beauty to that which I have deſcribed. It breaks out from under one of the mounds cloſe to the river. Its eruptions are, I think, in ſome reſpects, more beautiful than thoſe of the former. They riſe nearly to the ſame height, and the quantity of water thrown up at one time is greater, and not ſo much ſcattered into ſpray. The jets continue ſeldom longer than a minute, and the intervals between them are from five to ſix minutes. They are forced to bend forwards from the well, by the ſhelving of the bank, or probably their height would be very conſiderable; for they appear to be thrown up with great force. We never dared approach near enough to look deep into the well; but we could perceive the water boiling near its ſurface, from time to time, with much violence. The ground in front of it, was covered with a white incruſtation, of a more beautiful appearance than the depoſition near any other ſpring in this place. By a trial of it with acids, it ſeemed almoſt entirely calcareous.

I HAVE now deſcribed to you the two moſt remarkable fountains in the valley of Rykum, the only two which throw up water to a conſiderable height with any regularity. There are ſome from whence, in the courſe of every hour or half hour, beautiful jets burſt out unexpectedly; but their eruptions continue only a few ſeconds, and between them the water boils in the ſame manner as in the other baſons.

TOWARDS the upper end of the valley, there was a very curious hole, which attracted much of our attention. It ſeemed to have ſerved at ſome former period as the well of a fountain. It was of an irregular form, and from four to five feet in diameter. It was divided into different hollows or cavities at the depth of a few feet, into which we could not ſee a great way,

on

on account of their direction. A quantity of ſteam iſſued from theſe receſſes, which prevented us from examining them very cloſely. We were ſtunned while ſtanding near this cavern, and in ſome meaſure alarmed, by an amazing loud and continued noiſe which came from the bottom. It was as loud as the blaſt of air forced into the furnace from the four great cylinders at the Carron iron-works.

We could diſcover no water in any of the cavities; but we found near the place many beautiful petrifactions of leaves and moſſes. They were formed with extreme delicacy, but were brittle, and would not bear much handling; their ſubſtance ſeemed chiefly argillaceous.

We perceived ſmoke iſſuing from the ground in many places in the higher parts of the valley, much further than we extended our walks. I am ſorry to ſay we left many things in this wonderful country unexamined; but we were checked in our journey by many circumſtances, which allowed us neither the leiſure nor the opportunity for exploring every part of it as we could have wiſhed. The ſubſtances depoſited near the different ſprings ſeemed to me, in general, a mixture of calcareous and argillaceous earths; but near one ſpring, not far from our tents, there ſeemed to be a ſlight depoſition of ſiliceous matter. To the eye it reſembled calcedony; but with its tranſparency, it had not the ſame hardneſs, and, if preſſed, would break to pieces. The water you have analyſed came from this ſpring, and we were obliged to take ſome care in filling the bottles; for though gradually heated, they would break when the water was poured into them, if it had not been previouſly expoſed to the air for ſome minutes in an open veſſel.

The water of this ſpring boiled, as in moſt of the others, in a cauldron four or five feet broad. I do not recollect to have ſeen any of it ever thrown up above a foot, and ſome meat we dreſſed in it taſted very ſtrongly of ſulphur.

Mr

Mr BAINE, by a meafurement of the depth, the breadth and the velocity of the ftream flowing from the little Geyzer, found the quantity of water thrown up every minute by it to be 590.64 wine gallons, or 78.96 cubic feet. Mr WRIGHT and myfelf followed the ftream, to obferve how far any matter continued to be depofited by the water. We found fome little ftill depofited where it joined the river, a quarter of a mile at leaft from its fource. At that place, it retained the heat of 83 degrees by FAHRENHEIT's thermometer.

THE vegetation on the banks of the ftream, and in the pleafant meadows through which it flows, is exceedingly luxuriant. The farmer and his people were at this time employed in cutting the hay in them, which, though not high, was thick, and remarkably fweet. The plants which Mr WRIGHT found in the greateft perfection, were the fedum acre *, the veronica becabunga †, the polygonum viviparum ‡, and the comarum paluftre ||.

A LITTLE above, where the current from the little Geyzer falls into the river, part of the lava, which has defcended from the upper into the lower plain, has affumed clofe to its banks, for the fpace of fome yards, a regular columnar fhape. The pillars are fhort, and have five or fix fides. I cannot be very exact in my account of them, as they were on the oppofite fide of the river. I fhould fuppofe they were nearly a foot and an half in diameter. Some were horizontal, and others vertical. We obferved the fame appearance in many of the tracts of lava we traverfed on our journey, and, in one or two inftances, in thofe which had flowed from the fides of Mount Hecla, though the pillars there were lefs perfectly defined.

So many ftreams of hot water fall into the river, that it receives from thence a very perceptible degree of heat. The thermometer,

* Pepper ftone crop.

† Brook lime.

‡ Snake weed.

|| Purple marfh ariquefoil.

thermometer, immerſed in it above where it is joined by the waters of the Little Geyzer, roſe to 67 degrees, while in the open air it ſtood at 60. The breadth of the river in the ſame place is forty feet; its mean depth two feet and an half, and its courſe is rather rapid. Several kinds of fiſh are found in it; in particular, numbers of very fine ſalmon.

THE village of Rykum or Ryka, called either indiſcriminately, from *Ryk*, an Icelandic word, ſignifying ſmoke, is ſituated in the middle of the valley, and, by an obſervation made by Mr BAINE, is in latitude 64° 4′ 38″ N. about twenty miles from Rykiavick, and eight or ten from Oreback, a ſmall harbour on the ſouthern coaſt of the iſland. The village conſiſts of the farmer's houſe, and the houſes of his ſervants or dependants, and a ſmall church. All the adjacent lands belong to him, and he keeps a conſiderable number of ſheep and cattle, and ſome few horſes. Theſe conſtitute his riches; and he purchaſes at Rykiavick, with ſkins, wool and butter, whatever he requires, of which the chief article is fiſh, for his winter's proviſion.

I HAVE now related to you every circumſtance that has occurred to me worth mentioning concerning this intereſting valley. I have regretted much, however, my inability to give you a more accurate account of ſome parts of it; in particular, of the many ſprings which break out near the hills to the north, and of the rocks above the field where we placed our tents, which deſerved more attention than I gave to them. But we remained in this valley a ſhort time only, and the weather, during our continuance there, was very unfavourable. I ſhall here cloſe this letter, and reſerve for another (which you may very ſoon expect) the account I have yet to ſend you of the Great Geyzer and the ſprings near Haukadal. I am, Dear Sir, with great eſteem, your moſt obedient ſervant,

JOHN THO. STANLEY.

VI. *An* ACCOUNT *of the* HOT SPRINGS *near Haukadal in Iceland: In a ſecond Letter to Dr* BLACK *from* JOHN THOMAS STANLEY, *Eſq;* M. P. F. S. A. A. LOND. and F. R. S. EDIN.

[*Read April* 30. 1792.]

DEAR SIR, *Groſvenor Place*, *March* 30. 1792.

PART of my promiſe has been accompliſhed in a former letter, in which I gave you the fulleſt account I could of the ſprings of boiling water that riſe in the valley of Rykum. It now remains for me to ſend you a deſcription of thoſe we viſited in the neighbourhood of Haukadal.

THESE laſt are the moſt remarkable in the iſland, and the eruptions of water from ſome of them ſo aſtoniſhing, that I doubt whether any adequate idea of their effect can be given by deſcription. Abler pens than mine might fail probably in attempting to do juſtice to ſuch wonderful phenomena. The objects, however, are ſo highly intereſting in themſelves, that even the ſimpleſt narrative that can be given of them will be read with more than ordinary attention.

THEY are ſituated about ſix and thirty miles from Mount Heckla, and about twelve miles, in a north-eaſt direction, from the village of Skalholt *. The road from thence to the ſprings is

* Skalholt conſiſts of the Cathedral, a large building of wood, and of a very few houſes belonging to the Biſhop and his dependants. The Biſhops of the ſouthern diviſion

is over a flat country, which, although marſhy in ſeveral places, is not unpleaſant to the eye, and abounds in excellent paſturage.

The ſteam aſcending from the principal ſprings during their eruptions, may be ſeen from a conſiderable diſtance. When the air is ſtill, it riſes perpendicularly like a column to a great height; then ſpreads itſelf into clouds, which roll in ſucceſſive maſſes over each other, until they are loſt in the atmoſphere. We perceived one of theſe columns, when diſtant ſixteen miles at leaſt, in a direct line from Haukadal.

The ſprings moſtly riſe in a plain, between a river that winds through it, and the baſe of a range of low hills. Many however break out from the ſides of the hills, and ſome very near their ſummits. They are all contained, to the number of one hundred or more, within a circle of two miles.

The moſt remarkable ſpring riſes nearly in the midſt of the other ſprings, cloſe to the hills. It is called Geyzer *; the name probably in the old Scandinavian language for a fountain, from the verb *geyſa*, ſignifying *to guſh*, or *to ruſh forth*. The next moſt remarkable ſpring riſes at a diſtance of one hundred and forty yards from it, on the ſame line, at the foot of the hills. We called it the New Geyzer, on account of its having but lately played ſo violently as at preſent.

There are others of conſequence in the place, but none that approach to theſe in magnificence, or that, when compared with them, deſerve much deſcription. The generality of the ſprings are in every reſpect ſimilar to thoſe near Rykum; boil-

 ing

ſion of Iceland have always reſided there; but in future their reſidence will be at Rykiavick, a town now building on the ſouth-weſt coaſt of the iſland. The preſent Biſhop, however, the worthy and learned Mr Finsen, has obtained the permiſſion of continuing his reſidence at Skalholt during the remainder of his life.

* Three or four only of the principal ſprings in Iceland are diſtinguiſhed by the name of Geyzer, and of all the ſprings near Haukadal the greateſt is alone called Geyzer or Great Geyzer.

ing in caldrons of three or four feet diameter, and ſome of them throwing their water from time to time by ſudden jets into the air. Many ſprings in this place, as in the other, boil through ſtrata of coloured clay, by which they are rendered turbid. Here, however, the red clays were brighter, and in a greater proportion to the clays of other colours. Here alſo, as in the valley of Rykum, are many ſmall ſprings, which throw out ſulphureous vapour, and near which the ground, and the channel of the water, are covered and lined with a thin coat of ſulphur.

THE farm of Haukadal, and the church of the pariſh, ſtand near to each other about three quarters of a mile beyond the great ſpring. The houſe is one of the beſt built in Iceland. It occupies a large ſpace of ground, and conſiſts of ſeveral diviſions, to each of which there is an entrance from without. Some of theſe are uſed as barns and ſtables for the cattle, and others as work-ſhops *. The dwelling part of this houſe was ſmall, but comfortable. There was a parlour with glaſs windows, a kitchen, and ſeparate bed-chambers for the family. The building was partly of ſtone, partly of wood, and covered with ſods, under which the bark of birch trees on boards are generally placed, as a greater ſecurity againſt rain.

WE were obliged to the miſtreſs of this farm, who was a rich widow, for a very hoſpitable reception, although at firſt ſhe ſeemed to conſider us rather as unwelcome viſitors, and left us, though we had requeſted admittance into her houſe, as we were drenched with rain, and our tents and baggage not yet arrived, to take up our lodging in the church. We had not been long there, however, before ſhe invited us to her houſe, and

* As the diviſion of labour is yet very imperfect in Iceland, the farmer is under the neceſſity, either of exerciſing himſelf the ſeveral trades required in the formation of the inſtruments of agriculture, or of maintaining ſuch ſervants as are capable to ſupply them.

and by her kindneſs made ample amends for her former inattention. She put us in poſſeſſion of her beſt room, and ſet before us plenty of good cream, ſome wheat cakes, ſugar, and a kind of tea made of the leaves of the *dryas octopetala* *.

I MENTION theſe circumſtances of our reception at Haukadal, as characteriſtic of the manners of the Icelanders. Several times during my ſtay in the country, I experienced this ſucceſſion of civility to coldneſs. The Icelanders are naturally good, but not eaſily rouſed to feeling. When once their conſtitutional indifference was overcome, we uſually found them deſirous of pleaſing, and zealous to do us ſervice.

As the houſe was not ſufficiently large to contain the whole of our party, we were under the neceſſity of returning again to the church as ſoon as our baggage arrived. Here we paſſed the firſt and ſecond nights of our ſtay, in the neighbourhood of the ſprings. On the third day, we left Haukadal, to fix ourſelves in ſome ſtation nearer to them, from which we could watch their eruptions with more convenience.

THE view from near the church was very beautiful. It extended toward the ſouth along the plain into an open country. On the other ſides, it was bounded by hills, which had not the barren and rugged appearance that deform almoſt every ſcene in this diviſion of the iſland. It was, however, ſtill finer from ſome of the eminences near the ſprings. The plain and the ſurrounding mountains, ſeen from a height, appeared to more advantage; and the eruptions from the great wells breaking from time to time, the general ſtillneſs that prevailed, were much more diſtinct. The courſe of the river, winding under the eye, could be traced with greater accuracy. It flows through the

* Called in Engliſh the Mountain Avens. We found this plant growing very luxuriantly, and in great abundance, in every part of Iceland that we viſited.

the plain into an open country, where, being increafed by the waters of numerous ftreams and rivulets, it bends to the weftward, and near Skalholt falls into a confiderable river, the Huit-aa.

The pleafant and fertile paftures near its banks were enlivened by numerous herds of cattle and fheep, the united riches of three or four farmers in the neighbourhood of Haukadal. The mowers alfo at work in the different fields furrounding each houfe, gave, at this feafon, additional beauty to the profpect. High hills to the weftward were feparated from the eminencies immediately above the fprings by a narrow valley. They were partly clothed with bufhes of birch, which, although in no place above five feet high, were gratifying to the fight, which fo feldom in Iceland can reft on any appearance even of underwood. Above thefe, fome vegetation ftill continued to cover the fides of the hills, and Mr Wright found a variety of plants * near their fummits, which were certainly, in fome places, not lefs than fixteen hundred feet above the plain.

To the eaftward, the plain, feveral miles in breadth, was bounded by a long range of blue mountains, extending confiderably to the fouth. Beyond thefe, the triple fummit of Heckla may be feen from the weftern hills; but I could not diftinguifh it from the plain, or even from the heights whence the view of the furrounding country was taken which I am now defcribing.

To the north behind Haukadal, there were many high mountains, but at a great diftance, and of which the moft diftant were covered with fnow. They formed part of a dreary affemblage

* Amongft others, he found the *falix herbacea* (teft willow), the *ceraftium tomentofum* (woolly moufe ear chickweed), the *rumex digynus* (round leaved mountain forrel), and the *koenigia*, (a plant peculiar to Iceland), growing in great abundance, though generally in low and marfhy grounds.

aſſemblage of *Jokuls* or ice-mountains, which occupy a conſiderable extent of the interior country. Their forms were moſtly conical; and from their general reſemblance to other mountains in the iſland, from which ſtreams of lava have been emitted, I think it probable they were once volcanos. They are not ſo connected as to form a continued range or chain of hills. Each ſtands inſulated; and therefore the ſnows which have for ages reſted on their ſides, are no where accumulated in valleys and converted into lakes of ice and glaciers, as amidſt the Alps of Switzerland and Savoy.

A VIEW ſo different from the general features of the country, impreſſed us with the moſt agreeable ſenſations. Hitherto we could but compare one ſcene of drearineſs with another; and although the view before us was deſtitute of trees, yet the verdure, and pleaſant diſtribution of hills and plain, in ſome meaſure compenſated for this deficiency.

I NOW return to the account of the ſprings, which I have already obſerved break out in different places from the ſides of a hill, and the ſpace incloſed between its baſe and the windings of a river. The ſoil through which they riſe is a mixture of crumbled materials, waſhed by degrees from the higher parts of the hill. In ſome places, theſe have been reduced into a clay or earth; in others, they ſtill remain looſe and broken fragments of the rocks from whence they have fallen, or a duſt produced by their friction againſt each other. Wherever the ground is penetrated by the ſteam of the ſprings, theſe fragments are ſoon decompoſed, or changed into coloured clays. In other places, the ſurface of the ground is covered with incruſtations depoſited by the ſprings, or with a luxuriant vegetation of graſs or dwarf buſhes of willow and birch, and the *empetrum nigrum* *, the berries of which were at this time ripe and in great abundance.

ABOVE

* The crow berry. This is almoſt the only fruit we met with in Iceland. Mr WRIGHT found a few ſtrawberries. Neither gooſeberries nor currants will come to perfection by any management whatever.

Above the great ſpring, the hill terminates in a double pointed rock, which Mr Baine found by meaſurement to be 310 feet higher than the courſe of the river. The rock is ſplit very ſtrangely into lamina, and at firſt ſight has much the appearance of a ſchiſtus or bed of thick ſlate. It conſiſts, however, of a gray coloured ſtone of a very cloſe grain, the ſeparate pieces of which, although divided as they lay, do not break in the hand in any particular direction. I ſhould ſuppoſe the ſubſtance of this rock to be chiefly argillaceous, and that, like every other ſtone in the iſland, it has ſuffered ſome change by the action of fire. I do not mean to call it lava, as it bears no mark of having been once in a melted ſtate, whatever baking or induration it may have ſuſtained in the neighbourhood of ſubterraous heat. It contains no heterogeneous matter, or cavities, in which agates, or zeolites, or vitrified ſubſtances of any kind, could have been formed.

All theſe rocks that have been either altered or created by fire, ſeem much more liable to decay and decompoſition than any others I have ever ſeen. Mounds, ſimilar to thoſe in the valley of Rykum, have been formed by the ruins of the hill half way up its aſcent between the Geyzer and the pointed rock. Springs boil in many places through theſe mounds, and near to one of them, I obſerved that the coloured clay felt much more ſoapy than any I had tried before. This quality probably was owing to a greater proportion of the earth of magneſia in its compoſition, as in other reſpects it agreed perfectly with the reſt.

My attention, during the four days I remained in this place, was ſo much engaged by the beauties and remarkable circumſtances of the two principal ſprings, that I cannot (were I ſo inclined) give you a minute account of thoſe which, next to them, were deſerving of notice. The ſprings in general reſemble thoſe at Rykum; but there are five or ſix which have their peculiarities, and throw up their waters with violence to a

a confiderable height. Their bafons are of irregular forms, four, five or fix feet in diameter, and from fome of them the water rufhes out in all directions, from others obliquely. The eruptions are never of long duration, and the intervals are from 15 to 30 minutes. The periods of both were exceedingly variable. One of the moft remarkable of thefe fprings threw out a great quantity of water, and from its continual noife we named it the Roaring Geyzer. The eruptions of this fountain were inceffant. The water darted out with fury every four or five minutes, and covered a great fpace of ground with the matter it depofited. The jets were from thirty to forty feet in height. They were fhivered into the fineft particles of fpray, and furrounded by great clouds of fteam. The fituation of this fpring was eighty yards diftant from the Geyzer, on the rife of the hill.

I SHALL now, Sir, attempt fome defcription of this celebrated fountain, diftinguifhed by the appellation of Geyzer alone, from the pre-eminence it holds over all the natural phenomena of this kind in Iceland.

BY a gradual depofition of the fubftances diffolved in its water for a long fucceffion of years, perhaps for ages, a mound of confiderable height has been formed, from the centre of which the Geyzer iffues. It rifes through a perpendicular and cylindrical pipe, or fhaft, feventy feet in depth, and eight feet and a half in diameter, which opens into a bafon or funnel, meafuring fifty-nine feet from one edge of it to the other. The bafon is circular, and the fides of it, as well as thofe of the pipe, are polifhed quite fmooth by the continual friction of the water, and they are both formed with fuch mathematical truth, as to appear conftructed by art. The declivity of the mound begins immediately from the borders of the bafon. The incruftations are in fome places worn fmooth by the overflowing of the water; in moft, however, they rife in numberlefs little tufts, which bear a refemblance to the heads of cau-

 liflowers,

liflowers, except that they are rather more prominent, and are covered, by the falling of the finer particles of ſpray, with a cryſtalline effloreſcence ſo delicate as ſcarcely to bear the ſlighteſt touch. Unmoleſted, the effloreſcence gradually hardens, and, although it loſes its firſt delicacy, it ſtill remains exceedingly beautiful.

These incruſtations are of a light brown colour, and extend a great way, in various directions, from the borders of the baſon. To the northward, they reach to a diſtance of 82 feet; to the eaſt, of 86; to the ſouth, of 118; and of 124 to the weſt. They are very hard, and do not appear, in any part, decaying or mouldering into ſoil*.

When our guides firſt led us to the Geyzer, the baſon was filled to within a few feet of its edge. The water was tranſparent as cryſtal; a ſlight ſteam only aroſe from it, and the ſurface was ruffled but by a few bubbles, which now and then came from the bottom of the pipe. We waited with anxiety for ſeveral minutes, expecting at every inſtant ſome interruption to this tranquillity. On a ſudden, another ſpring, immediately in front of the place on which we were ſtanding, darted its waters above an hundred feet into the air with the velocity of an arrow, and the jets ſucceeding this firſt eruption were ſtill higher. This was the ſpring already mentioned under the name of the New Geyzer.

While gazing in ſilence and wonder at this unexpected and beautiful diſplay, we were alarmed by a ſudden ſhock of the ground

* The ſubſtance of theſe incruſtations has been analyſed by Profeſſor Bergman, and he gives a long and particular account of it, in a letter to the Archbiſhop of Upſal, publiſhed with the Archbiſhop's Letters on Iceland. He ſays, "The ſtrongeſt acids, the "fluor acid not excepted, are not ſufficient with a boiling heat to diſſolve this ſubſtance. "It diſſolves very little (if at all) by the blow-pipe with the fuſible ſalt of urine, a little "more with borax, and makes a ſtrong efferveſcence with ſal ſodæ. Theſe effects are "peculiar only to a ſiliceous earth or flint. There cannot remain therefore a doubt "concerning the nature of this cruſtated ſtone."

ground under our feet, accompanied with a hollow noiſe, not unlike the diſtant firing of cannon. Another ſhock ſoon followed, and we obſerved the water in the baſon to be much agitated. The Icelanders haſtily laid hold of us, and forced us to retreat ſome yards. The water in the mean time boiled violently, and heaved as if ſome expanſive power were labouring beneath its weight, and ſome of it was thrown up a few feet above the baſon. Again there were two or three ſhocks of the ground, and a repetition of the ſame noiſe. In an inſtant, the ſurrounding atmoſphere was filled with volumes of ſteam rolling over each other as they aſcended, in a manner inexpreſſibly beautiful, and through which, columns of water, ſhivering into foam, darted in rapid ſucceſſion to heights which, at the time, we were little qualified to eſtimate. Indeed, the novelty and ſplendour of ſuch a ſcene had affected our imaginations ſo forcibly, that we believed the extreme height of the jet to be much greater than it was afterwards determined to be. In a ſubſequent eruption, Mr Baine aſcertained, by means of a quadrant, the greateſt elevation to which the jets of water were thrown, to be 96 feet.

Much of the water began to deſcend again at different heights, and was again projected by other columns, which met it as they aroſe. At laſt, having filled the baſon, it rolled in great waves over its edge, and forming numberleſs rills, made its way down the ſides of the mound. Much was loſt in vapour alſo, and ſtill more fell to the ground in heavy ſhowers of ſpray. The intervals at which the ſeveral jets ſucceeded each other, were too ſhort for the eye to diſtinguiſh them. As they roſe out of the baſon, they reflected, by their denſity, the pureſt and moſt brilliant blue. In certain ſhades, the colour was green like that of the ſea; but in their further aſcent, all diſtinction of colour was loſt, and the jets, broken into a thouſand parts, appeared white as ſnow. Several of them were forced upwards perpendicularly; but many, receiving

a ſlight inclination as they burſt from the baſon, were projected in beautiful curves, and the ſpray which fell from them, caught by a ſucceeding jet, was hurried away ſtill higher than it had been perhaps before.

The jets were made with inconceivable velocity, and thoſe which eſcaped uninterrupted terminated in ſharp points, and loſt themſelves in the air. The eruption, changing its form at every inſtant, and blending variouſly with the clouds of ſteam that ſurrounded it, continued for ten or twelve minutes; the water then ſubſided through the pipe, and diſappeared.

The eruptions of the Geyzer ſucceed each other with ſome degree of regularity, but they are not equally violent, or of equal duration. Some laſted ſcarcely eight or ten, while others continued, with unabated violence, fifteen or eighteen minutes. Between the great eruptions, while the pipe and baſon were filling, the water burſt ſeveral times into the air to a conſiderable height. Theſe partial jets, however, ſeldom exceeded a minute, and ſometimes not a few ſeconds, in duration.

After the eruption of it had been violent, the water ſank into ſubterraneous caverns, and left the pipe quite empty. If the eruption had been moderate, the ſubſidence of the water was proportionably leſs. The firſt time the pipe was perfectly emptied, we ſounded its depth, and found the bottom very rough and irregular. The pipe remains but a ſhort time empty. After a few ſeconds, the water ruſhes into it again with a bubbling noiſe, and during the time that it is riſing in the pipe, it is frequently darted ſuddenly into the air to different heights, ſometimes to two or three, ſometimes ſixty feet above the ſides of the baſon. By a ſurpriſe of this kind, while we were engaged meaſuring the diameter of the well, we had nearly been ſcalded; and although we were able to withdraw ourſelves from the great body of water as it aſcended, yet we remained expoſed to the falling ſpray, which fortunately was ſo much cooled in the air as to do us no miſchief.

Of

Of thefe jets we counted twenty in an hour and an half, during which the waters had filled the pipe and in part the bafon. It then feemed oftentimes agitated, and boiled with great violence. The jets were more beautiful, and continued longer, as the quantity of water in the bafon increafed. The refiftance being greater, their force was in fome degree broken, and their form, more divided, produced a greater difplay of foam and vapour.

While the pipe was filling, we threw into it feveral ftones of confiderable weight, which, whenever the water burft forth with any violence, were projected much higher than itfelf. Thefe ftones in falling were met by other columns of water, and amidft thefe they rofe and fell repeatedly. They were eafily diftinguifhed in the white foam, and contributed much to the novelty and beauty of this extraordinary phenomenon.

When the bafon was nearly full, thefe occafional eruptions were generally announced by fhocks of the ground, fimilar to thofe preceding the great eruptions. Immediately after the fhocks, the whole body of water in the bafon heaved exceedingly; a violent ebullition then took place, and large waves fpread themfelves in circles from the centre, through which the column forced its way.

When the water had been quiet in the bafon for fome time, the thermometer placed in it ftood at 180° only, but immediately after an eruption it rofe to 200°. We boiled a piece of falmon in it, which was exceedingly well tafted. Our cookery at Rykum had not been quite fo fuccefsful.

The water thrown out from the Geyzer is joined at the bottom of the mound by that which flows from the fpring called the roaring Geyzer, formerly defcribed. The ftream produced by their united waters flows three or four hundred paces before it falls into the river, where its temperature is reduced to 72°. Even at this place it depofited much of the fubftances it contained; but during the whole of its courfe, the plants

growing

growing on its banks were covered with beautiful incruſtations. Some of theſe we wiſhed to preſerve, but from their extreme delicacy they fell into pieces on every attempt to remove them.

The ſituation of the new Geyzer * is in the ſame line from the foot of the hill with the great Geyzer. Its pipe is formed with equal regularity, and is ſix feet in diameter, and forty-ſix feet ten inches in depth. It does not open into a baſon, but it is nearly ſurrounded by a rim or wall two feet high. After each eruption, the pipe is emptied, and the water returns gradually into it, as into that of the old Geyzer. During three hours nearly that the pipe is filling, the partial eruptions happen ſeldom, and do not riſe very high; but the water boils the whole time, and often with great violence. The temperature of the waters after one of theſe eruptions, was conſtantly found to be 212°. Few incruſtations are formed round this ſpring, excepting in the channel where the water flows from it.

The great eruption is not preceded by any noiſe, like that of the great Geyzer. The water boils ſuddenly, or is heaved over the ſides of the pipe; then ſubſiding a little, it burſts into the air with inconceivable violence. The column of water remains entire, until it reaches its extreme height, where it is ſhivered into the fineſt particles. Its direction was perpendicular, and greateſt elevation 132 feet. Like the eruption of the old Geyzer, this conſiſted of ſeveral jets, ſucceeding each other with

* Before the month of June 1789, the year I viſited Iceland, this ſpring had not played with any great degree of violence, at leaſt for a conſiderable time. (Indeed the formation of the pipe will not allow us to ſuppoſe, that its eruptions had at no former period been violent.) But in the month of June, this quarter of Iceland had ſuffered ſome very ſevere ſhocks of an earthquake; and it is not unlikely, that many of the cavities communicating with the bottom of the pipe, had been then enlarged, and new ſources of water opened into them. The difference between the eruptions of this fountain, and thoſe of the great Geyzer, may be accounted for from the circumſtance of their being no baſon over the pipe of the firſt, in which any water can be contained to interrupt the column as it riſes. I ſhould here ſtate, that we could not diſcover any correſpondence between the eruptions of the different ſprings.

with great rapidity. Whatever we threw into the well was hurled into the air with ſuch ſwiftneſs that the eye could ſcarcely diſcern it *, and the diviſion of the water at the extremity of the column was ſo minute, that the ſhowers of ſpray which fell were cold. Towards the end of an eruption, when more ſteam than water ruſhed from the pipe, I ventured to hold my hand near the edge of the column, in the way of ſome of the divided particles of water, and found them tepid only. You may probably think this a raſh experiment, and certainly it was ſo. But we had made our obſervations on the uniform direction of the column, and confided our ſafety in it. Once or twice, however, we had reaſon to think ourſelves more fortunate in eſcaping, than prudent in avoiding, the danger which attended a too near approach to theſe eruptions of boiling water. During ten or fifteen minutes, the water continued to be thrown upwards with undiminiſhed impetuoſity. At the end of that period, the quantity became leſs, and at length, ceaſing entirely, ſteam alone aſcended. In one inſtance, the eruption continued thirty minutes. It ſeldom however exceeded twenty minutes, and ſometimes was completed in fifteen minutes. The force with which the ſteam riſes abates as the water ſinks in the pipe, and when this is exhauſted, that ſoon diſappears.

I HAVE now, Sir, given you ſuch a deſcription of theſe celebrated fountains as was in my power. I hope that it will afford you ſome ſatisfaction, and I could wiſh that it might ſerve as an inducement to ſome curious enquirer into the hiſtory of nature to viſit them, who ſhall have all the knowledge requiſite for making ſuch obſervations as are yet to be deſired concerning them. I cannot flatter myſelf, that the deſcription I have attempted of their eruptions will impreſs you with a juſt idea of their beauty. Sources of compariſon are wanting, by which the

* Mr BAINE meaſured the height to which a ſtone was thrown up by one of theſe jets, and found it 129 feet. Some others roſe conſiderably higher.

the portraiture of ſuch extraordinary ſcenes can be aſſiſted. Nature no where offers objects bearing a reſemblance to them; and art, even in conſtructing the water-works of Verſailles, has produced nothing that can at all illuſtrate the magnificent appearances of the Geyzer. All then that I hope for is, to have ſaid ſo much as may enable you to complete in your imagination, the picture which I have only ſketched. Imagination alone can ſupply the noiſe and motion which accompany ſuch large bodies of water burſting from their confinement; and muſt be left to paint, what I have not been able to deſcribe, the brilliancy of colouring, the purity of the ſpray, the quick change of effect, and the thouſand varieties of form into which the clouds of ſteam, filling the atmoſphere on every ſide, are rolled inceſſantly.

I HAVE avoided entering into any theory of the cauſe of theſe phenomena, that you may not ſuppoſe the account I give you has been biaſſed by a favourite hypotheſis. I have given you an accurate ſtate of facts, and I leave to you the explanation of them. There cannot, however, be two opinions concerning the immediate cauſe which forces the water upwards. It is obviouſly the elaſticity of ſteam endeavouring to free itſelf. In addition to this, the form of the cylinder through which the water riſes, gives it that projectile force which carries it ſo high. Beyond this, it would not become me to hazard any opinion.

OF the antiquity of theſe ſprings I can ſay nothing, further than that they are mentioned as throwing up their waters to a great height by SAXO GRAMMATICUS, in the Preface to his Hiſtory of Denmark, which was written in the twelfth century; but from the general features of the country, it is likely, that they have exiſted a great length of time. The operations of ſubterraneous heat ſeem indeed to be of great antiquity in Iceland, and the whole country probably owes its exiſtence

iſtence to the fires which burn beneath its ſurface. Every hill proves, at leaſt, with what violence theſe fires have acted for ages; and the terrible eruptions of lava, which burſt from the mountains of Skaptefield in 1783, ſhow that they are as yet far from being extinguiſhed.

I am,

Dear Sir,

With great regard and eſteem,

Your very obedient ſervant,

JOHN THO. STANLEY.

VII. *On the* ORIGIN *and* INVESTIGATION *of* PORISMS. *By JOHN PLAYFAIR,* F. R. S. EDIN. *and Professor of Mathematics in the University of* EDINBURGH.

PART I.

[*Read April* 2. 1792.]

1. THE restoration of the ancient books of geometry would have been impossible, without the coincidence of two circumstances, of which, though the one is purely accidental, the other is essentially connected with the nature of the mathematical sciences. The first of these circumstances is the preservation of a short abstract of those books, drawn up by PAPPUS ALEXANDRINUS, together with a series of such *lemmata*, as he judged useful to facilitate the study of them. The second is, the *necessary connection* that takes place among the objects of every mathematical work, which, by excluding whatever is arbitrary, makes it possible to determine the whole course of an investigation, when only a few points in it are known. From the union of these circumstances, mathematics has enjoyed an advantage of which no other branch of knowledge can partake; and while the critic or the historian has only been able to lament the fate of those books of LIVY and TACITUS which are lost, the geometer has had the high satisfaction to behold the works of EUCLID and APOLLONIUS reviving under his hands.

2. THE first restorers of the ancient books were not, however, aware of the full extent of the work which they had undertaken.

dertaken. They thought it ſufficient to demonſtrate the propoſitions, which they knew from PAPPUS, to have been contained in thoſe books; but they did not follow the ancient method of inveſtigation, and few of them appear to have had any idea of the elegant and ſimple analyſis by which theſe propoſitions were originally diſcovered, and by which the Greek geometry was peculiarly diſtinguiſhed.

AMONG theſe few, FERMAT and HALLEY are to be particularly remarked. The former, one of the greateſt mathematicians of the laſt age, and a man in all reſpects of ſuperior abilities, had very juſt notions of the geometrical analyſis, and appears often abundantly ſkilful in the uſe of it; yet in his reſtoration of the *Loci Plani*, it is remarkable, that in the moſt difficult propoſitions, he lays aſide the analytical method, and contents himſelf with giving the ſynthetical demonſtration. The latter, among the great number and variety of his literary occupations, found time for a moſt attentive ſtudy of the ancient mathematicians, and was an inſtance of, what experience ſhews to be much rarer than might be expected, a man equally well acquainted with the ancient and the modern geometry, and equally diſpoſed to do juſtice to the merit of both. He reſtored the books of APOLLONIUS, on the problem *De Sectione Spatii*, according to the true principles of the ancient analyſis.

THESE books, however, are but ſhort, ſo that the firſt reſtoration of conſiderable extent that can be reckoned complete, is that of the *Loci Plani* by Dr SIMSON, publiſhed in 1749, which, if it differs at all from the work it is intended to replace, ſeems to do ſo only by its greater excellence. This much at leaſt is certain, that the method of the ancient geometers does not appear to greater advantage in the moſt entire of their writings, than in the reſtoration above mentioned; and that Dr SIMSON has often ſacrificed the elegance to which his own analyſis would have led, in order to tread more exactly in what

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the *lemmata* of PAPPUS pointed out to him, as the tract which APOLLONIUS had purfued.

3. THERE was another fubject, that of *Porifms*, the moft intricate and enigmatical of any thing in the ancient geometry, which was ftill referved to exercife the genius of Dr SIMSON, and to call forth that enthufiaftic admiration of antiquity, and that unwearied perfeverance in refearch, for which he was fo peculiarly diftinguifhed. A treatife in three books, which EUCLID had compofed on Porifms, was loft, and all that remained concerning them was an abftract of that treatife, inferted by PAPPUS ALEXANDRINUS in his *Mathematical Collections*, in which, had it been entire, the geometers of later times would doubtlefs have found wherewithal to confole themfelves for the lofs of the original work. But unfortunately it has fuffered fo much from the injuries of time, that all which we can *immediately* learn from it is, that the ancients put a high value on the propofitions which they called porifms, and regarded them as a very important part of their analyfis. The Porifms of EUCLID are there faid to be, "Collectio artificio-"fiffima multarum rerum quæ fpectant ad analyfin diffici-"liorum et generalium problematum *." The curiofity, however, which is excited by this encomium is quickly difappointed; for when PAPPUS proceeds to explain what a Porifm is, he lays down two definitions of it, one of which is rejected by him as imperfect, while the other, which is ftated as correct, is too vague and indefinite to convey any ufeful information.

THESE defects might neverthelefs have been fupplied, if the enumeration which he next gives of EUCLID's propofitions had been entire; but on account of the extreme brevity of his enunciations, and their reference to a diagram which is loft, and for the conftructing of which no directions are given, they are all, except one, perfectly unintelligible. For thefe reafons, the fragment

* Collectiones Math. lib. vii. in init.

fragment in queſtion is ſo obſcure, that even to the learning and penetration of Dr HALLEY, it ſeemed impoſſible that it could ever be explained; and he therefore concluded, after giving the Greek text with all poſſible correctneſs, and adding the Latin tranſlation, "Hactenus Poriſmatum deſcriptio nec "mihi intellecta, nec lectori profutura. Neque aliter fieri po-"tuit, tam ob defectum ſchematis cujus fit mentio, quam ob "omiſſa quædam et tranſpoſita, vel aliter vitiata in propoſi-"tionis generalis expoſitione, unde quid ſibi velit PAPPUS haud "mihi datum eſt conjicere. His adde dictionis modum nimis "contractum, ac in re difficili, qualis hæc eſt, minime uſur-"pandum *."

4. IT is true, however, that before this time, FERMAT had attempted to explain the nature of Poriſms, and not altogether without ſucceſs †. Guiding his conjectures by the definition which PAPPUS cenſures as imperfect, becauſe it defined poriſms only "ab accidente," *viz.* "Poriſma eſt quod deficit hy-"potheſi a Theoremate Locali," he formed to himſelf a tolerably juſt notion of theſe propoſitions, and illuſtrated his general deſcription by examples that are in effect Poriſms. But he was able to proceed no farther; and he neither proved, that his notion of a Poriſm was the ſame with EUCLID's, nor attempted to reſtore, or explain any one of EUCLID's propoſitions; much leſs did he ſuppoſe, that they were to be inveſtigated by an analyſis peculiar to themſelves. And ſo imperfect indeed was this attempt, that the complete reſtoration of the Poriſms was neceſſary to prove, that FERMAT had even approximated to the truth.

5. ALL this did not, however, deter Dr SIMSON from turning his thoughts to the ſame ſubject, which he appears to have done

* De ſectione rationis, proem. p. 37.

† "Poriſmatum EUCLIDÆORUM renovata doctrina, et ſub forma Iſagoges exhibita." FERMAT Opera Varia, p. 116.

done very early, and long before the publication of the *Loci Plani* in 1749. The account he gives of his progreſs, and of the obſtacles he encountered, will be always intereſting to mathematicians. " Poſtquam vero apud PAPPUM legeram Poriſ-
" mata EUCLIDIS collectionem fuiſſe artificioſiſſimam multarum
" rerum, quæ ſpectant ad analyſin difficiliorum et generalium
" problematum, magno deſiderio tenebar, aliquid de iis cognoſ-
" cendi; quare ſæpius et multis variiſque viis tum PAPPI propoſi-
" tionem generalem, mancam et imperfectam, tum primum lib. i.
" Poriſma, quod ſolum ex omnibus in tribus libris integrum ad-
" huc manet, intelligere et reſtituere conabar; fruſtra tamen,
" nihil enim proficiebam. Cumque cogitationes de hac re
" multum mihi temporis conſumpſerint, atque moleſtæ admo-
" dum evaſerint, firmiter animum induxi hæc nunquam in
" poſterum inveſtigare; præſertim cum optimus geometra
" HALLEIUS ſpem omnem de iis intelligendis abjeciſſet. Un-
" de quoties menti occurrebant, toties eas arcebam. Poſtea
" tamen accidit, ut improvidum et propoſiti immemorem in-
" vaſerint, meque detinuerint donec tandem lux quædam efful-
" ſerit, quæ ſpem mihi faciebat inveniendi ſaltem PAPPI pro-
" poſitionem generalem, quam quidem multa inveſtigatione
" tandem reſtitui. Hæc autem paulo poſt una cum Poriſmate
" primo lib. i. impreſſa eſt inter Tranſactiones Phil. anni 1723,
" No. 177 *."

THE propoſitions here mentioned, as inſerted in the Philoſophical Tranſactions for 1723, are all that Dr SIMSON publiſhed on the ſubject of Poriſms during his life, though he continued his inveſtigations concerning them, and ſucceeded in reſtoring a great number of EUCLID's propoſitions, together with their analyſis. The propoſitions thus reſtored form a part of that valuable edition of the poſthumous works of this geometer which the mathematical world owes to the munificence of the late Earl STANHOPE.

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* ROB. SIMSON Op. reliqua, p. 319.

6. THE fubject of Porifms is not, however, exhaufted, nor is it yet placed in fo clear a light as to need no farther illuftration. It yet remains to enquire into the probable origin of thefe propofitions, that is to fay, into the fteps by which the ancient geometers appear to have been led to the difcovery of them. It remains alfo to point out the relations in which they ftand to the other claffes of geometrical truths; to confider the fpecies of analyfis, whether geometrical or algebraical, that belongs to them; and, if poffible, to affign the reafon why they have fo long efcaped the notice of modern mathematicians. It is to thefe points that the following obfervations are chiefly directed.

I BEGIN with defcribing the fteps that appear to have led the ancient geometers to the difcovery of Porifms; and muft here fupply the want of exprefs teftimony by probable reafonings, fuch as are neceffary, whenever we would trace remote difcoveries to their fources, and which have more weight in mathematics than in any other of the fciences.

7. IT cannot be doubted, that it has been the folution of problems which, in all ftates of the mathematical fciences, has led to the difcovery of moft geometrical truths. The firft mathematical enquiries, in particular, muft have occurred in the form of queftions, where fomething was given, and fomething required to be done; and by the reafonings neceffary to anfwer thefe queftions, or to difcover the relation between the things that were given, and thofe that were to be found, many truths were fuggefted, which came afterwards to be the fubjects of feparate demonftration. The number of thefe was the greater, that the ancient geometers always undertook the folution of problems with a fcrupulous and minute attention, which would fcarcely fuffer any of the collateral truths to efcape their obfervation. We know from the examples which they have left us, that they never confidered a problem as refolved, till they had diftinguifhed all its varieties, and evolved feparately every different cafe that

that could occur, carefully remarking whatever change might arife in the conftruction, from any change that was fuppofed to take place among the magnitudes which were given.

Now, as this cautious method of proceeding was not better calculated to avoid error, than to lay hold of every truth that was connected with the main object of enquiry, thefe geometers foon obferved, that there were many problems which, in certain circumftances, would admit of no folution whatever, and that the general conftruction by which they were refolved would fail, in confequence of a particular relation being fuppofed among the quantities which were given. Such problems were then faid to become impoffible; and it was readily perceived, that this always happened, when one of the conditions prefcribed was inconfiftent with the reft, fo that the fuppofition of their being united in the fame *fubject*, involved a contradiction. Thus, when it was required to divide a given line, fo that the rectangle under its fegments, fhould be equal to a given fpace, it was evident, that if this fpace was greater than the fquare of half the given line, the thing required could not poffibly be done; the two conditions, the one defining the magnitude of the line, and the other that of the rectangle under its fegments, being then inconfiftent with one another. Hence an infinity of beautiful propofitions concerning the *maxima* and the *minima* of quantities, or the limits of the poffible relations which quantities may ftand in to one another.

8. Such cafes as thefe would occur even in the folution of the fimpleft problems; but when geometers proceeded to the analyfis of fuch as were more complicated, they muft have remarked, that their conftructions would fometimes fail, for a reafon directly contrary to that which has now been affigned. Inftances would be found where the lines that, by their interfection, were to determine the thing fought, inftead of interfecting one another, as they did in general, or of not meeting at all, as in the above mentioned cafe of impoffibility, would coincide

with

with one another entirely, and leave the queftion of confequence unrefolved. But though this circumftance muft have created confiderable embarraffment to the geometers who firft obferved it, as being perhaps the only inftance in which the language of their own fcience had yet appeared to them ambiguous or obfcure, it would not probably be long till they found out the true interpretation to be put on it. After a little reflection, they would conclude, that fince, in the general problem, the magnitude required was determined by the interfection of the two lines above mentioned, that is to fay, by the points common to them both; fo, in the cafe of their coincidence, as all their points were in common, every one of thefe points muft afford a folution; which folutions therefore muft be infinite in number; and alfo, though infinite in number, they muft all be related to one another, and to the things given, by certain laws, which the pofition of the two coinciding lines muft neceffarily determine.

On enquiring farther into the peculiarity in the ftate of the data which had produced this unexpected refult, it might likewife be remarked, that the whole proceeded from one of the conditions of the problem involving another, or neceffarily including it; fo that they both together made in fact but one, and did not leave a fufficient number of independent conditions, to confine the problem to a fingle folution, or to any determinate number of folutions. It was not difficult afterwards to perceive, that thefe cafes of problems formed very curious propofitions, of an intermediate nature between problems and theorems, and that they admitted of being enunciated feparately, in a manner peculiarly elegant and concife. It was to fuch propofitions, fo enunciated, that the ancient geometers gave the name of *Porifms*.

9. This deduction requires to be illuftrated by examples. Suppofe therefore that it is propofed to refolve the following problem:

PROP. I. PROB. FIG. I.

A CIRCLE A B C, a ſtraight line D E, and a point F, being given in poſition, to find a point G in the ſtraight line D E, ſuch that G F, the line drawn from it to the given point, ſhall be equal to G B, the line drawn from it touching the given circle.

SUPPOSE the point G to be found, and G B to be drawn touching the circle A B C in B; let H be the centre of the circle A B C; join H B, and let H D be perpendicular to D E; from D draw D L, touching the circle A B C in L, and join H L. Alſo from the centre G, with the diſtance G B or G F, deſcribe the circle B K F, meeting H D in the points K and K′.

IT is plain, that the lines H D and D L are given in poſition and in magnitude. Alſo, becauſe G B touches the circle A B C, H B G is a right-angle; and ſince G is the centre of the circle B K F, therefore H B touches the circle B K F, and conſequently the ſquare of H B, or of H L, is equal to the rectangle K′ H K. But the rectangle K′ H K, together with the ſquare of D K, is equal to the ſquare of D H, becauſe K K′ is biſected in D; therefore the ſquares of H L and D K are alſo equal to the ſquare of D H. But the ſquares of H L and L D are equal to the ſame ſquare of D H; wherefore the ſquare of D K is equal to the ſquare of D L, and the line D K to the line D L. But D L is given in magnitude; therefore D K is given in magnitude, and K is therefore a given point. For the ſame reaſon, K′ is a given point, and the point F being alſo given by hypotheſis, the circle B K F is given in poſition. The point G therefore, the centre of the circle B K F is given, which was to be found.

HENCE

HENCE this conſtruction: Having drawn H D perpendicular to D E, and D L touching the circle A B C, make D K and D K′ each equal to D L, and find G the centre of a circle deſcribed through the points K, F and K′; that is, let F K′ be joined, and biſected at right angles by the line M N, which meets D E in G; G will be the point required, or it will be ſuch a point, that if G B be drawn from it, touching the circle A B C, and G F to the given point, G B and G F will be equal to one another *.

THE ſynthetical demonſtration needs not be added; but it is neceſſary to remark, that there are caſes in which this conſtruction fails altogether.

FOR, firſt, if the given point F be any where in the line H D, as at F′, it is evident, that M N becomes parallel to D E, and that the point G is no where to be found, or, in other words, is at an infinite diſtance from D.

THIS is true in general; but if the given point F coincide with K, then the line M N evidently coincides with D E; ſo that, agreeably to a remark already made, every point of the line D E may be taken for G, and will ſatisfy the conditions of the problem; that is to ſay, G B will be equal to G K, wherever the point G be taken in the line D E. The ſame is true if F coincide with K′.

THIS is eaſily demonſtrated ſynthetically; for if G be any point whatſoever in the line D E, from which G B is drawn touching the circle A B C; if D K and D K′ be each made equal to D L; and if a circle be deſcribed through the points B, K, and K′; then, ſince the rectangle K H K′, together with the ſquare of D K, that is, of D L, is equal to the ſquare of

 D H,

* This ſolution of the problem was ſuggeſted to me by Profeſſor ROBISON; and is more ſimple than that which I had originally given.

D H, that is, to the ſquares of D L and L H, the rectangle K H K′ is equal to the ſquare of H B, ſo that H B touches the circle B K K′. But B G is at right-angles to H B; therefore the centre of the circle B K K′ is in the line B G; and it is alſo in the line D E; therefore G is the centre of the circle B K K′, and G B is equal to G K.

THUS we have an inſtance of a problem, and that too a very ſimple one, which is in general determinate, admitting only of one ſolution, but which nevertheleſs, in one particular caſe, where a certain relation takes place among the things given, becomes indefinite, and admits of innumerable ſolutions. The propoſition which reſults from this caſe of the problem is a Poriſm, according to the remarks that were made above, and in effect will be found to coincide with the 66th propoſition in Dr SIMSON's Reſtoration. It may be thus enunciated: "A circle A B C being given in poſition, and alſo a ſtraight line D E, which does not cut the circle, a point K may be found, ſuch that if G be any point whatever in the line D E, the ſtraight line drawn from G to the point K, ſhall be equal to the ſtraight line drawn from G, touching the circle A B C."

10. THE following Poriſm is alſo derived in the ſame manner from the ſolution of a very ſimple problem:

PROP. II. PROB. FIG. 2.

A TRIANGLE A B C being given, and alſo a point D, to draw through D a ſtraight line D G, ſuch, that, perpendiculars being drawn to it from the three angles of the triangle, *viz.* A E, B G, C F, the ſum of the two perpendiculars on the ſame ſide of D G, ſhall be equal to the remaining

maining perpendicular; or, that A E and B G together, may be equal to C F.

Suppose it done: Bifect A B in H, join C H, and draw H K perpendicular to D G.

Because A B is bifected in H, the two perpendiculars A E and B G are together double of H K; and as they are alfo equal to C F by hypothefis, C F muft be double of H K, and C L of L H. Now, C H is given in pofition and magnitude; therefore the point L is given; and the point D being alfo given, the line D L is given in pofition, which was to be found.

The conftruction is obvious. Bifect A B in H, join C H, and take H L equal to one-third of C H; the ftraight line which joins the points D and L is the line required.

Now, it is plain, that while the triangle A B C remains the fame, the point L alfo remains the fame, wherever the point D may be. The point D may therefore coincide with L; and when this happens, the pofition of the line to be drawn is left undetermined; that is to fay, any line whatever drawn through L will fatisfy the conditions of the problem.

Here therefore we have another indefinite cafe of a problem, and of confequence another Porifm, which may be thus enunciated: "A triangle being given in pofition, a point in it may be found, fuch, that any ftraight line whatever being drawn through that point, the perpendiculars drawn to this ftraight line from the two angles of the triangle which are on one fide of it, will be together equal to the perpendicular that is drawn to the fame line from the angle on the other fide of it."

11. This Porifm may be made much more general; for if, inftead of the angles of a triangle, we fuppofe ever fo many points to be given in a plane, a point may be found, fuch, that any ftraight line being drawn through it, the fum of all the perpendiculars that fall on that line from the given points on

one

one ſide of it, is equal to the ſum of the perpendiculars that fall on it from all the points on the other ſide of it.

Or ſtill more generally, any number of points being given not in the ſame plane, a point may be found, through which if any plane be ſuppoſed to paſs, the ſum of all the perpendiculars which fall on that plane from the points on one ſide of it, is equal to the ſum of all the perpendiculars that fall on the ſame plane from the points on the other ſide of it.

It is unneceſſary to obſerve, that the point to be found in theſe propoſitions, is no other than the centre of gravity of the given points; and that therefore we have here an example of a Poriſm very well known to the modern geometers, though not diſtinguiſhed by them from other theorems.

12. The problem which follows appears to have led to the diſcovery of more than one Poriſm.

PROP. III. PROB. Fig. 3.

A circle A B C, and two points D and E, in a diameter of it being given, to find a point F in the circumference of the given circle, from which, if ſtraight lines be drawn to the given points E and D, theſe ſtraight lines ſhall have to one another the given ratio of α to β *.

Suppose the problem reſolved, and that F is found, ſo that F E has to F D the given ratio of α to β. Produce E F any how to B, biſect the angle E F D by the line F L, and the angle D F B by the line F M.

Then, becauſe the angle E F D is biſected by F L, E L is to L D as E F to FD, that is, in a given ratio; and as E D is given, each of the ſegments E L, L D, is given, and alſo the point L.

Again,

* The ratio of α to β is ſuppoſed that of a greater to a leſs.

Again, becauſe the angle D F B is biſected by F M, E M is to M D as E F to F D, that is, in a given ratio; and therefore, ſince E D is given, E M, M D, are alſo given, and likewiſe the point M.

But becauſe the angle L F D is half of the angle E F D, and the angle D F M half of the angle D F B, the two angles L F D, D F M, are equal to the half of two right angles, that is, to a right angle. The angle L F M being therefore a right angle, and the points L and M being given, the point F is in the circumference of a circle deſcribed on the diameter L M, and conſequently given in poſition.

Now, the point F is alſo in the circumference of the given circle A B C; it is therefore in the interſection of two given circumferences, and therefore is found.

Hence this conſtruction: Divide E D in L, ſo that E L may be to L D in the given ratio of α to β; and produce E D alſo to M, ſo that E M may be to M D in the ſame given ratio of α to β. Biſect L M in N, and from the centre N, with the diſtance N L, deſcribe the ſemicircle L F M, and the point F, in which it interſects the circle A B C, is the point required, or that from which F E and F D are to be drawn.

The ſynthetical demonſtration follows ſo readily from the preceding analyſis, that it is not neceſſary to be added.

It muſt however be remarked, that the conſtruction fails when the circle L F M falls either wholly without, or wholly within the circle A B C, ſo that the circumferences do not interſect; and in theſe caſes the ſolution is impoſſible. It is plain alſo, that in another caſe the conſtruction will fail, *viz.* when it ſo happens that the circumference L F M wholly coincides with the circumference A B C. In this caſe, it is farther evident, that every point in the circumference A B C will anſwer the conditions of the problem, which therefore admits of innumerable ſolutions, and may, as in the foregoing inſtances, be converted into a Poriſm.

13. We

13. We are therefore to enquire, in what circumſtances the point L may coincide with the point A, and the point M with with the point C, and of conſequence the circumference L F M with the circumference A B C.

On the ſuppoſition that they coincide, E A is to A D, and alſo E C to C D, as α to β; and therefore E A is to E C as A D to C D, or, by converſion, E A to A C as A D to the exceſs of C D above A D, or to twice D O, O being the centre of the circle A B C. Therefore alſo, E A is to A O, or the half of A C, as A D to D O, and E A together with A O, to A O, as A D together with D O, to D O; that is, E O to A O as A O to D O, and ſo the rectangle E O. O D equal to the ſquare of A O.

Hence, if the ſituation of the given points E and D, (fig. 4.) in reſpect of the circle A B C, be ſuch, that the rectangle E O. O D is equal to the ſquare of A O, the ſemidiameter of the circle; and if, at the ſame time, the given ratio of α to β be the ſame with that of E A to A D, or of E C to C D, the problem admits of innumerable ſolutions; and as it is manifeſt, that if the circle A B C, and one of the points D or E be given, the other point, and alſo the ratio which is required to render the problem indefinite, may be found, therefore we have this Poriſm: "A circle A B C being given, and alſo a point D, a point E may be found, ſuch, that the two lines inflected from theſe points to any point whatever in the circumference A B C, ſhall have to one another a given ratio, which ratio is alſo to be found."

This Poriſm is the ſecond in the treatiſe *De Poriſmatibus*, where Dr Simson gives it, not as one of Euclid's propoſitions, but as an illuſtration of his own definition. It anſwers equally well for the purpoſe I have here in view, the explaining the origin of Poriſms; and I have been the more willing to introduce it, that it has afforded me an opportunity of giving what ſeems to be the ſimpleſt inveſtigation of the ſecond propoſition in the ſecond book of the *Loci Plani*, by proving, as has been done above,

above, that on the hypothesis of that proposition, L F M (fig. 3.) is a right angle, and L and M given points.

14. Hence also an example of the derivation of Porisms from one another. For the circle A B C, and the points E and D, remaining as in the last construction, (fig. 4.) if through D we draw any line whatever H D B, meeting the circle in B and H, and if the lines E B, E H be also drawn, these lines will cut off equal circumferences B F and H G. Let F C be drawn, and it is plain from the foregoing analysis, that the angles D F C, C F B are equal. Therefore if O G, O B be drawn, the angles B O C, C O G are equal, and consequently the angles D O B, D O G. In the same manner, by joining A B, the angle D B E being bisected by B A, it is evident, that the angle A O F is equal to the angle A O H, and therefore the angle F O B to the angle H O G, that is, the arch F B to the arch H G.

Now, it is plain, that if the circle A B C, and one of the points D or E be given, the other point may be found; therefore we have this Porism, which appears to have been the last but one in the third book of Euclid's Porisms *. "A point being given, either without or within a circle given in position, if there be drawn, any how through that point, a line cutting the circle in two points; another point may be found, such, that if two lines be drawn from it to the points, in which the line already drawn cuts the circle, these two lines will cut off from the circle equal circumferences."

There are other Porisms that may be deduced from the same original problem, (§ 12.) all connected, as many remarkable properties of the circle are, with the *harmonical division* of the diameter.

15. The preceding proposition also affords a good illustration of the general remark that was made above, concerning the conditions of a problem being involved in one another, in the Porismatic, or indefinite case. Thus, several independent conditions are here laid down, by help of which the problem is to

* Simson De Porismatibus, Prop. 53.

be refolved : Two points D and E are given, (fig. 3.) from which two lines are to be inflected, and a circumference A B C, in which thefe lines are to meet, as alfo a ratio, which they are to have to one another *. Now, thefe conditions are all independent of each other, fo that any one of them may be changed, without any change whatever in the reft. This at leaft is true in general; but neverthelefs in one cafe, *viz.* when the given points are fo related to one another, that the rectangle under their diftances from the centre, is equal to the fquare of the radius of the circle, it follows from the foregoing analyfis, that the ratio which the inflected lines are to have to one another, is no longer a matter of choice, but is a neceffary confequence of this difpofition of the points. For if any other ratio were now affigned than that of A O to O D, or, which is the fame, of E A to A D, it would eafily be fhewn, that no lines having that ratio could be inflected from the points E and D, to any point in the circle A B C. Two of the conditions are therefore reduced into one; and hence it is that the problem is indefinite.

16. FROM this account of the origin of Porifms, it follows, that a Porifm may be defined, *A propofition affirming the poffibility of finding fuch conditions as will render a certain problem indeterminate, or capable of innumerable folutions.*

To this definition, the different characters which PAPPUS has given will apply without difficulty. The propofitions defcribed in it, like thofe which he mentions, are, ftrictly fpeaking, neither theorems nor problems, but of an intermediate nature between both; for they neither fimply enunciate a truth to be demonftrated, nor propofe a queftion to be refolved; but are affirmations of a truth, in which the determination of an unknown quantity is involved. In as far therefore as they affert, that a certain problem may become indeterminate, they are of the nature of theorems; and in as far as they feek to difcover the

* The given points, and the centre of the given circle, are underftood, throughout, to be in the fame ftraight line.

the conditions by which that is brought about, they are of the nature of problems.

17. In the preceding definition alſo, and the inſtances from which it is deduced, we may trace that imperfect deſcription of Poriſms which Pappus aſcribes to the later geometers, *viz.* "Poriſma eſt quod deficit hypotheſi a theoremate locali." Now, to underſtand this, it muſt be obſerved, that if we take the converſe of one of the propoſitions called *Loci*, and make the conſtruction of the figure a part of the hypotheſis, we have what was called by the ancients a Local Theorem. And again, if, in enunciating this theorem, that part of the hypotheſis which contains the conſtruction be ſuppreſſed, the propoſition ariſing from thence will be a Poriſm; for it will enunciate a truth, and will alſo require, to the full underſtanding and inveſtigation of that truth, that ſomething ſhould be found, *viz.* the circumſtances in the conſtruction, ſuppoſed to be omitted.

Thus, when we ſay; If from two given points E and D, (fig. 4.) two lines E F and F D are inflected to a third point F, ſo as to be to one another in a given ratio, the point F is in the circumference of a circle given in poſition: we have a *Locus*.

But when converſely it is ſaid; If a circle A B C, of which the centre is O, be given in poſition, as alſo a point E, and if D be taken in the line E O, ſo that the rectangle E O.O D be equal to the ſquare of A O, the ſemidiameter of the circle; and if from E and D, the lines E F and D F be inflected to any point whatever in the circumference A B C; the ratio of E F to D F will be a given ratio, and the ſame with that of E A to A D: we have a local theorem.

And, laſtly, when it is ſaid; If a circle A B C be given in poſition, and alſo a point E, a point D may be found, ſuch, that if the two lines E F and F D be inflected from E and D to any point whatever F, in the circumference, theſe lines ſhall

have a given ratio to one another: the propofition becomes a Porifm, and is the fame that has been juft inveftigated.

HERE it is evident, that the local theorem is changed into a Porifm, by leaving out what relates to the determination of the point D, and of the given ratio. But though all propofitions formed in this way, from the converfion of *Loci*, be Porifms, yet all Porifms are not formed from the converfion of *Loci*. The firft and fecond of the preceding, for inftance, cannot by converfion be changed into *Loci*; and therefore the definition which defcribes all Porifms as being fo convertible, is not fufficiently comprehenfive. FERMAT's idea of Porifms, as has been already obferved, was founded wholly on this definition, and therefore could not fail to be imperfect.

18. IT appears, therefore, that the definition of Porifms given above, (§ 16.) agrees with PAPPUS's idea of thefe propofitions, as far at leaft as can be collected from the imperfect fragment which contains his general defcription of them. It agrees alfo with Dr SIMSON's definition, which is this *: "Porifma eft propofitio in qua proponitur demonftrare rem aliquam, vel plures datas effe, cui, vel quibus, ut et cuilibet ex rebus innumeris, non quidem datis, fed quæ ad ea quæ data funt eandem habent relationem, convenire oftendendum eft affectionem quandam communem in propofitione defcriptam."

IT cannot be denied, that there is a confiderable degree of obfcurity in this definition †; notwithftanding of which, it is certain,

* SIMSON's Opera Reliqua, p. 323.

† THE following tranflation will perhaps be found to remedy fome of the obfcurity complained of.

"A PORISM is a propofition, in which it is propofed to demonftrate, that one or more things are given, between which and every one of innumerable other things, not given, but affumed according to a given law, a certain relation, defcribed in the propofition, is to be fhewn to take place."

IT

certain, that every propofition to which it applies muft contain a *problematical* part, *viz.* " in qua proponitur demonftrare rem " aliquam, vel plures datas effe;" and alfo a *theoretical* part, which contains the property, or *communis affectio*, affirmed of certain things which have been previoufly defcribed.

It is alfo evident, that the fubject of every fuch propofition is the relation between magnitudes of three different kinds; determinate magnitudes, which are given; determinate magnitudes, which are to be found; and indeterminate magnitudes, which, though unlimited in number, are connected with the others by fome common property. Now, thefe are exactly the conditions contained in the definition that has been given here.

19. To confirm the truth of this theory of the origin of Porifms, or at leaft the juftnefs of the notions founded on it, I muft add a quotation from an Effay on the fame fubject, by a member of this Society, the extent and correctnefs of whofe views make every coincidence w th his opinions peculiarly flattering. In a paper read feveral years ago before the Philofophical Society, Profeffor DUGALD STEWART defined a Porifm to be, " A propofition affirming the poffibility of find- " ing one or more of the conditions of an indeterminate theo- " rem;" where, by an indeterminate theorem, as he had previoufly explained it, is meant one which expreffes a relation between certain quantities that are determinate, and certain others that are indeterminate, both in magnitude and in number. The near agreement of this with the definition and explanations which have been given above, is too obvious to require

It may be proper to remark, that there is an ambiguity in the word *given*, as ufed here and on many other occafions, where it denotes indifferently things that are both *determinate* and *known*, and things that, though *determinate*, are *unknown*, provided they can be found. This holds as to the firft application of the term in the above definition; from which however no inconveniency arifes, when the reader is apprifed of it. In the courfe of this paper, I have endeavoured, as much as poffible, to avoid the like ambiguity.

quire to be pointed out; and I have only to obſerve, that it was not long after the publication of Simson's poſthumous works, when, being both of us occupied in ſpeculations concerning Poriſms, we were led ſeparately to the concluſions which I have now ſtated *.

20. We

* In an enquiry into the origin of Poriſms, the etymology of the term ought not to be forgotten. The queſtion indeed is not about the derivation of the word Πορισμα, for concerning that there is no doubt; but about the reaſon why this term was applied to the claſs of propoſitions above deſcribed. Two opinions may be formed on this ſubject, and each of them with conſiderable probability.

1mo, One of the ſignifications of ποριζω, is *to acquire* or *obtain;* and hence Πορισμα, *the thing obtained* or *gained*. Accordingly, Scapula ſays, *Eſt vox a geometris deſumpta qui theorema aliquid ex demonſtrativo ſyllogiſmo neceſſario ſequens inferentes, illud quaſi* lucrari *dicuntur, quod non ex profeſſo quidem theorematis hujus inſtituta ſit demonſtratio, ſed tamen ex demonſtratis recte ſequatur*. In this ſenſe, Euclid uſes the word in his Elements of Geometry, where he calls the corollaries of his propoſitions, *Poriſmata*. This circumſtance creates a preſumption, that when the word was applied to a particular claſs of propoſitions, it was meant, in both caſes, to convey nearly the ſame idea, as it is not at all probable, that ſo correct a writer as Euclid, and ſo ſcrupulous in his uſe of words, ſhould employ the ſame term to expreſs two ideas which are perfectly different. May we not therefore conjecture, that theſe propoſitions got the name of Poriſms, entirely with a reference to their origin. According to the idea explained above, they would in general occur to mathematicians when engaged in the ſolution of the more difficult problems, and would ariſe from thoſe particular caſes, where one of the conditions of the data involved in it ſome one of the reſt. Thus, a particular kind of theorem would be obtained, following as a corollary from the ſolution of the problem; and to this theorem the term Πορισμα might be very properly applied, ſince, in the words of Scapula, already quoted, *Non ex profeſſo theorematis hujus inſtituta ſit demonſtratio, ſed tamen ex demonſtratis recte ſequatur.*

2do, But though this interpretation agrees ſo well with the ſuppoſed origin of Poriſms, it is not free from difficulty. The verb ποριζω has another ſignification, *to find out, to diſcover, to deviſe;* and is uſed in this ſenſe by Pappus, when he ſays, that the propoſitions called Poriſms, afford great delight, τοις δυναμενοις ορᾳν και ποριζειν, *to thoſe who are able to underſtand and* investigate. Hence comes πορισμος, *the act of finding out*, or *diſcovering*, and from πορισμος, in this ſenſe, the ſame author evidently conſiders Πορισμα as being derived. His words are, Εφασαν δε (οἱ αρχαιοι) Πορισμα ειναι το προτεινομενον εις Πορισμον αυτȣ τȣ προτεινομενȣ, *the ancients ſaid, that a Poriſm is ſomething propoſed for the* finding out, *or* discovering *of the very thing propoſed.* It ſeems ſingular, however, that Poriſms ſhould have taken their name from a circumſtance common to them with ſo many other geometrical truths; and if this was really the caſe, it muſt have been on account of the ænigmatical form of their enunciation, which required, that in the analyſis of theſe propoſitions, a ſort of double diſcovery ſhould be made, not only of the truth, but alſo of the meaning *of the very thing which was propoſed.* They may therefore have been called *Poriſmata* or *Inveſtigations,* by way of eminence.

20. We might next proceed to conſider the particular Poriſms which Dr Simson has reſtored, and to ſhew, that every one of them is the indeterminate caſe of ſome problem. But of this it is ſo eaſy for any one, who has attended to the preceding remarks, to ſatisfy himſelf, by barely examining the enunciations of thoſe propoſitions, that the detail into which it would lead ſeems to be unneceſſary. I ſhall therefore go on to make ſome obſervations on that kind of *analyſis* which is particularly adapted to the inveſtigation of Poriſms.

If the idea which we have given of theſe propoſitions be juſt, it follows, that they are always to be diſcovered, by conſidering the caſes in which the conſtruction of a problem fails, in conſequence of the lines which, by their interſection, or the points which, by their poſition, were to determine the magnitude required, happening to coincide with one another. A Poriſm may therefore be deduced from the problem it belongs to, in the ſame manner that the propoſitions concerning the *maxima* and *minima* of quantities are deduced from the problems of which they form the limitations; and ſuch no doubt is the moſt natural and moſt obvious analyſis of which this claſs of propoſitions will admit.

It is not, however, the only one that they will admit of; and there are good reaſons for wiſhing to be provided with another, by means of which, a Poriſm that is any how ſuſpected to exiſt, may be found out, independently of the general ſolution of the problem to which it belongs. Of theſe reaſons, one is, that the Poriſm may perhaps admit of being inveſtigated more eaſily than the general problem admits of being reſolved; and another is, that the former, in almoſt every caſe, helps to diſcover the ſimpleſt and moſt elegant ſolution that can be given of the latter.

The truth of this laſt obſervation has been already exemplified in two of the preceding problems, where the Poriſmatic caſe, by determining the point K in the firſt, and L in the

ſecond

ſecond of them, became neceſſary to the general ſolution. In more difficult problems, the ſame will be found to hold ſtill more remarkably, and this is evidently what PAPPUS had in view, when, in a paſſage already quoted, he called Poriſms, "Collectio artificioſiſſima multarum rerum quæ ſpectant ad "analyſin difficiliorum et generalium problematum."

ON this account, it is deſirable to have a method of inveſtigating Poriſms, which does not require, that we ſhould have previouſly reſolved the problems they are connected with, and which may always ſerve to determine, whether to any given problem there be attached a Poriſm, or not. Dr SIMSON's analyſis may be conſidered as anſwering to this deſcription; for as that geometer did not regard theſe propoſitions at all in the light that is done here, nor in relation to their origin, an independent analyſis of this kind, was the only one that could occur to him; and he has accordingly given one which is extremely ingenious, and by no means eaſy to be invented, but which he uſes with great ſkilfulneſs and dexterity throughout the whole of his Reſtoration.

IT is not eaſy to aſcertain whether this be the preciſe method uſed by the ancients. Dr SIMSON had here nothing to direct him but his genius, and has the full merit of the firſt inventor. It ſeems probable, however, that there is at leaſt a great affinity between the methods, ſince the *lemmata* given by PAPPUS as neceſſary to EUCLID's demonſtrations, are ſubſervient alſo to thoſe of our modern geometer.

21. I SHALL employ the ſame ſort of analyſis in the Poriſms that follow, at leaſt till we come to treat of them algebraically, where a method of inveſtigating theſe propoſitions will preſent itſelf, which is perhaps more ſimple and direct than any other. The following Poriſm is the firſt of EUCLID's, and the firſt alſo that was reſtored. It is given here to exemplify the advantage which, in inveſtigations of this kind, may be derived from employing the *law of continuity* in its utmoſt extent,

extent, and purſuing Poriſms to thoſe extreme caſes, where the indeterminate magnitudes increaſe *ad infinitum;* into which ſtate Dr SIMSON probably did not think it ſafe to follow them, and was thereby deprived of no inconſiderable help toward the ſimplifying of his conſtructions. If therefore it can be ſhewn, that this help may be obtained without any ſacrifice of geometrical accuracy, it will be ſome improvement in this branch of the analyſis.

THE Poriſm juſt mentioned may be conſidered as having occurred in the ſolution of a problem. Suppoſe it were required; two points A and B, (fig. 5.) and alſo three ſtraight lines D E, F K, K L, being given in poſition, together with two points H and M, in two of theſe lines, to inflect from A and B to a point in the third line, two lines that ſhall cut off from K F and K L two ſegments, adjacent to the given points H and M, having to one another the given ratio of α to β.

Now, in order to find whether there be any Poriſm connected with this problem, ſuppoſe that there is, and that the following propoſition is true.

PROP. IV. PORISM. FIG. 5.

22. Two points A and B, and two ſtraight lines D E and F K, being given in poſition, and alſo a point H in one of them, a line L K may be found, and alſo a point in it M, both given in poſition, ſuch, that A E and B E, inflected from the points A and B to any point whatſoever of the line D E, ſhall cut off from the other lines F K and L K, ſegments, H G and M N, adjacent to the given points H and M, having to one another the given ratio of α to β.

FIRST, let A E′, B E′ be inflected to the point E′, ſo that A E′ may be parallel to F K, then ſhall E′ B be parallel to K L,

 the

the line to be found. For if it be not parallel to K L, the point of their interfection muft be at a finite diftance from the point M, and therefore making as β to α. fo this diftance to a fourth proportional, the diftance from H, at which A E′ interfects F K, will be equal to that fourth proportional. But A E′ does not interfect F K, for they are parallel by conftruction; therefore B E′ cannot interfect K L; K L is therefore parallel to B E′, a line given in pofition.

Again, let A E″, B E″ be inflected to E″, fo that A E″ may pafs through the given point H; then it is plain, that B E″ muft pafs through the point to be found M; for if not, it may be demonftrated, juft as has been done above, that A E″ does not pafs through H, contrary to the fuppofition. The point to be found is therefore in the line E″B, which is given in pofition.

Now, if from E there be drawn E P parallel to A E′, and E S parallel to B E′, B S is to S E as B L to L N, and A P to P E as A F to F G; wherefore the ratio of F G to L N is compounded of the ratios of A F to B L, P E to S E, and B S to A P. But the ratio of P E to S E is the fame with that of A E′ to B E′, and the ratio of B S to A P is the fame with that of D B to D A, becaufe D B is to B S as D E′ to E′ E. or as D A to A P. Therefore the ratio of F G to L N is compounded of the ratios of A F to B L, A E′ to B E′, and D B to D A.

In like manner, becaufe E″ is a point in the line D E, and A E″, B E″ are inflected to it, the ratio of F H to L M, is compounded of the fame ratios of A F to B L, A E′ to B E′. and D B to D A; and therefore the ratio of F H to L M is the fame with that of F G to N L, and the fame confequently with that of H G to M N. But the ratio of H G to M N is given, being by fuppofition that of α to β; the ratio of F H to L M is therefore alfo given, and F H being given, L M is given in magnitude.

magnitude. Now, L M is parallel to B E′, a line given in position; therefore M is in a line Q M parallel to A B, and given in position. But the point M is alſo in another line B E″ given in poſition; therefore the point M, and alſo the line K L M drawn through it parallel to B E′, are given in poſition, which were to be found.

The conſtruction is thus: From A draw A E′ parallel to F K, meeting D E in E′; join B E′, and take in it B Q, ſo that as α to β ſo H F to B Q and through Q draw Q M parallel to A B. Let H A be drawn, and produced till it meet D E in E″, and let B E″ be drawn meeting Q M in M. Through M draw K M L parallel to B E′; then is K M L the line, and M the point, which were to be found.

It is plain, that there are two lines which will anſwer the conditions of the Poriſm; for if in Q B, produced on the other ſide of B, there be taken B q equal to B Q; and if $q\ m$ be drawn parallel to A B, interſecting M B in m; and if $m\ \lambda$ be drawn parallel to B Q, the part $m\ n$, cut off by E B produced, will be equal to M N, and have to H G the ratio required.

It is plain alſo, that whatever be the ratio of α to β, and whatever be the magnitude of F H, if the other things given remain the ſame, the lines found will be all parallel to B E′. But if the ratio of α to β remain the ſame likewiſe, and if only the point H vary, the poſition of K L will remain the ſame, and the point M will vary.

23. This conſtruction, from which, and the foregoing analyſis, the ſynthetical demonſtration follows readily, will be found to be more ſimple than Dr Simson's, owing entirely to the uſe that has been made of the *law of continuity* in the two extreme caſes, where, according to the language of the modern analyſis, H G becomes infinite, in the one, and equal to nothing, in the other. Had it been affirmed, agreeably to that ſame language, that in the firſt of thoſe caſes, becauſe of the conſtant

 ratio

ratio of H G to M N, theſe lines muſt both become infinite at the ſame time, and in the ſecond, that for the ſame reaſon they muſt both vaniſh at the ſame time, we might have been accuſed of departing from the ſtrict form of reaſoning employed in the ancient geometry. But when the thing is ſtated as above, and it is proved, that when A E′ does not meet K F, it is impoſſible for B E′ to meet M L; and again, that when A E″ paſſes through H, it is impoſſible for B E″ not to paſs through M, the air of paradox is entirely removed, and the tracing of the law of continuity is rendered perfectly conſiſtent with the utmoſt ſeverity of geometrical demonſtration.

Dr Simson has applied this Poriſm very ingeniouſly to the ſolution of the ſame problem from which it is here ſuppoſed to be derived *; and it is worthy of remark, that ſuppoſing the points A and B, and the lines D E and F K to be as in the figure of this Poriſm, if the third of the given lines be not parallel to B E′, that problem can always be reſolved, and admits of two ſolutions; but if it be parallel to B E′, the problem either becomes impoſſible, or a Poriſm; that is, it either admits of no ſolution, or of an infinite number. We ſhall ſoon have occaſion to extend the ſame obſervation to other Poriſms.

Another general remark which I have to make on the analyſis of Poriſms is, that it frequently happens, as in the laſt example, that the magnitudes required may all, or a part of them, be found by conſidering the extreme caſes; but for the diſcovery of the relation between them, and the indefinite magnitudes, or *res innumeræ*, we muſt have recourſe to the hypotheſis of the Poriſm in its moſt general, or indefinite form, and muſt endeavour ſo to conduct the reaſoning, that the indefinite magnitudes ſhall at length wholly diſappear, and leave a propoſition, containing only a relation of determinate magnitudes to one another. Now, in order to accompliſh this, Dr Simson

* Opera Reliqua, de Poriſmatibus, prop. 25.

SIMSON frequently employs two ſtatements of the general hypotheſis, which he compares together; as for inſtance, in his analyſis of the laſt Poriſm, he aſſumes, not only E, any point whatſoever in the line D E, but alſo another point O, any whatſoever in the ſame line, to both of which he ſuppoſes lines to be inflected from the given points A and B. This double ſtatement, however, cannot be made, without rendering the inveſtigation long and complicated; and therefore it may be of uſe to remark, that it is never neceſſary, but may always be avoided by an appeal to ſimpler Poriſms, or to *Loci*, or to the propoſitions of the *data*. I ſhall give the following Poriſm as an example, where this is done with ſome difficulty, but with conſiderable advantage, in regard to the ſimplicity and ſhortneſs of the inveſtigation.

PROP. V. PORISM. FIG. 6.

24. LET there be three ſtraight lines A B, A C, C B given in poſition, and from any point whatſoever in one of them, as D, let perpendiculars be drawn to the other two, as D F, D E; a point G may be found, ſuch, that if G D be drawn from it to the point D, the ſquare of that line ſhall have a given ratio to the ſum of the ſquares of the perpendiculars DF and D E, which ratio is to be found.

DRAW from A and B the lines A H, B K at right angles to B C and C A, and divide A B in L, ſo that A L may be to L B in the given ratio of the ſquare of A H to the ſquare of B K, or, which is the ſame, of the ſquare of A C to the ſquare of C B. The point L is therefore given; and if N be taken ſo as to have to A L the ſame ratio that AB^2 has to AH^2, N will be given in magnitude. Alſo ſince $AH^2 : BK^2 :: AL : LB$, and

and $AH^2 : AB^2 :: AL : N$, *ex æquo* $BK^2 : AB^2 :: LB : N$. From L draw LO, LM perpendicular to AC, CB; LO and LM are given in magnitude.

Now, becauſe $AB^2 : BK^2 :: AD^2 : DF^2$, $N : LB :: AD^2 : DF^2$, ſo that $DF^2 = \frac{LB}{N} \cdot AD^2$, and for the ſame reaſon, $DE^2 = \frac{AL}{N} \cdot BD^2$. But (*Loci Plani, Append. Lem.* 1.) $\frac{LB}{N} \cdot AD^2 + \frac{AL}{N} \cdot BD^2 = \frac{LB}{N} \cdot AL^2 + \frac{AL}{N} \cdot BL^2 + \frac{AB}{N} \cdot DL^2$; that is, $DE^2 + DF^2 = LO^2 + LM^2 + \frac{AB}{N} \cdot DL^2$.

Join LG; then by hypotheſis, $LO^2 + LM^2$ has to LG^2 the ſame ratio which $DF^2 + DE^2$ has to DG^2; and if this ratio be that of R to N, $LO^2 + LM^2 = \frac{R}{N} \cdot LG^2$; and therefore $DE^2 + DF^2 = \frac{R}{N} \cdot LG^2 + \frac{AB}{N} \cdot DL^2$. But $DE^2 + DF^2 = \frac{R}{N} \cdot DG^2$; therefore $\frac{R}{N} \cdot LG^2 + \frac{AB}{N} \cdot DL^2 = \frac{R}{N} \cdot DG^2$, and $\frac{AB}{N} \cdot DL^2 = \frac{R}{N}(DG^2 - LG^2)$. The exceſs of the ſquare of DG above the ſquare of LG, has therefore a conſtant ratio to the ſquare of DL, *viz.* that of AB to R. The angle DLG is therefore a right angle, and the ratio of AB to R, the ratio of equality, otherwiſe LD would be given in magnitude, which is contrary to the ſuppoſition. The line LG is therefore given in poſition; and ſince R is to N, that is, AB to N, as the ſquares of LO and LM to the ſquare of LG, therefore the ſquare of LG, and conſequently the line LG, is given in magnitude. The point G is therefore given, and alſo the ratio of

of the ſquares of D E and D F to the ſquare of D G, which is the ſame with that of A B to N.

HENCE this conſtruction: Divide A B in L, ſo that A L may be to L B as the ſquare of A H to the ſquare of B K, and make as the ſquare of A H to the ſquare of A B, ſo A L to N; and, laſtly, having drawn from L upon A C and C B the perpendiculars L O and L M, make L G perpendicular to AB, and ſuch that as A B to N, ſo the ſum of the ſquares of L O and L M to the ſquare of L G; G will be the point required, and the given ratio, which the ſquares on D F and D E have to the ſquare on D G, will be that of A B to N.

THIS is the conſtruction which follows moſt directly from the analyſis; but it may be rendered more ſimple. For ſince $AH^2 : AB^2 :: AL : N$, and $BK^2 : AB^2 :: BL : N$, therefore $AH^2 + BK^2 : AB^2 :: AB : N$. Likewiſe, if A G, B G be joined, $AB : N :: AH^2 : AG^2$, and $AB : N :: BK^2 : BG^2$; wherefore $AB : N :: AH^2 + BK^2 : AG^2 + BG^2$, that is, $AH^2 + BK^2 : AB^2 :: AH^2 + BK^2 : AG^2 + BG^2$, and $AG^2 + GB^2 = AB^2$. The angle A G B is therefore a right angle, and $AL : LG : LB$. If therefore A B be divided in L, as in the preceding conſtruction; and if L G, a mean proportional between A L and L B, be placed at right angles to AB, G will be the point required.

Cor. IT is evident from the conſtruction, that if at the points A and B we ſuppoſe weights to be placed that are as the ſquares of the ſines of the angles C A B, C B A, L will be the centre of gravity of theſe weights. For A L is to L B as AC^2 to CB^2, or inverſely as the ſquares of the ſines of the angles at A and B.

25. Now, the ſtep in this analyſis by which a ſecond introduction of the general hypotheſis is avoided, is that in which the angle G L D is concluded to be a right angle. This concluſion follows from the exceſs of the ſquare of D G above the ſquare of G L, having a given ratio to the ſquare of L D, at the ſame time that L D is of no determinate magnitude. For, if

if possible, let G L D be obtuse, (fig. 7.) and let the perpendicular from G upon A B meet A B in V, which point V is therefore given. And since the excess of the square of G D above the square of L G is equal to the square of L D, together with twice the rectangle D L V, therefore by the supposition, the square of L D, together with twice the rectangle D L V, must have a given ratio to the square of L D; the ratio of the rectangle D L V to the square of L D, that is, of V L to L D, is therefore given, so that V L being given in magnitude, L D is also given. But this is contrary to the supposition, for L D is indefinite by hypothesis; and therefore G L D cannot be obtuse, nor any other than a right angle.

The same conclusion that is here drawn immediately from the indetermination of L D, would be deduced, according to Dr Simson's method, by assuming another point D′, any how, and from the supposition, that the excess of G D'^2 above G L^2 was to L D'^2 in the same ratio that the excess of G D^2 above G L^2 is to L D^2, it would follow without much difficulty, that G L D must be a right angle, and the given ratio, a ratio of equality. The method followed above is shorter and less intricate than this last, and has, I think, the advantage of discovering more plainly the *spirit* of the analysis, and the effect which the indefinite nature of the quantities, supposed indeterminate in the Porism, has in ascertaining the relation, that must subsist between the magnitudes that are given, and those that are to be found.

26. This Porism may be extended to any number of lines whatsoever, and may be thus enunciated: " Let there be any number of straight lines given in position, and from any point in one of them, let perpendiculars be drawn to all the rest, a point may be found, such, that the square of the line joining it, and the point from which the perpendiculars are drawn, shall have to the sum of the squares of these perpendiculars a given ratio, which ratio is also to be found."

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The analyſis of the Poriſm, when thus generalized, is too long to be given here*. We muſt not, however, omit to take notice, that the point L, where the perpendicular from the point to be found meets the line, from which the perpendiculars are drawn to the reſt, is in all caſes determined by the rule ſuggeſted in the corollary. (§ 24.) For if at the points in which the ſaid line is interſected by the others, there be placed weights proportional to the ſquares of the ſines of the angles of interſection, L will be the centre of gravity of theſe weights.

27. These Poriſms facilitate the ſolution of the general problems from which they are derived. For if it were propoſed, three ſtraight lines AB, AC, BC being given in poſition, and alſo a point R, (fig. 6.) to find a point D in one of the given lines AB, ſuch, that the ſum of the ſquares of the perpendiculars drawn from D to the other two lines, ſhould have a given ratio to the ſquare of DR, it is plain, that the finding of the point G in the Poriſm, would render the conſtruction eaſy. For the ſquares of RD and GD, having each given ratios to the ſum of the ſquares of the perpendiculars drawn from D, have a given ratio to one another. The ratio of the lines, RD and GD themſelves, is therefore given, and the points R and G being given, D is in the circumference of a circle given in poſition; and it is alſo in the ſtraight line AB given in poſition; therefore it is given. The ſame holds, whatever be the number of lines given in poſition.

The ſame Poriſms aſſiſt alſo in the ſolution of another problem. For if it were propoſed to find D, ſo that the ſum

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* This Poriſm, in the caſe conſidered above, *viz.* when there are three ſtraight lines given in poſition, was communicated to me ſeveral years ago, without any analyſis or demonſtration, by Dr Trail, Prebendary of Liſburn in Ireland, who told me alſo, that he had met with it among ſome of Dr Simson's papers, which had been put into his hands, at the time when the poſthumous works of that geometer were preparing for the preſs. The application of it to the ſecond of the problems, (§ 27.) was alſo ſuggeſted by Dr Trail.

of the ſquares of the perpendiculars drawn from it to AC, and CB, ſhould be equal to a given ſquare, this would be done by finding G; and then becauſe the ſum of the ſquares of the perpendiculars is given, and has a given ratio to the ſquare of DG, DG will be given, and conſequently the point D. This is alſo true, whatever be the number of the lines.

28. THE connection of the Poriſms with the impoſſible caſes of theſe problems, is abundantly evident; the point L being that from which, if perpendiculars be drawn to AC and CB, the ſum of their ſquares is the leaſt poſſible. For ſince (fig. 6.) $DF^2+DE^2:DG^2::LO^2+LM^2:LG^2$, and ſince LG is leſs than DG, LO^2+LM^2 muſt be leſs than DF^2+DE^2.

HENCE alſo a point Q may be found, from which, if perpendiculars be drawn to the ſides of the triangle ABC, the ſum of the ſquares of theſe perpendiculars is leſs than the ſum of the ſquares of the perpendiculars drawn to the ſides of the triangle from any other point.

FOR if ab (fig. 8.) be any line drawn parallel to AB, and if it be divided in λ, ſo that $a\lambda$ may be to λb in the duplicate ratio of aC to Cb, or of AC to CB, then of all the points in the line ab, λ is that from which, if perpendiculars be drawn to the lines AC, CB, the ſum of their ſquares is the leaſt poſſible. But ſince $a\lambda$ is to λb as the ſquare of AC to the ſquare of BC, that is, as AL to LB, therefore the *locus* of λ is the ſtraight line LC, joining the given points L and C. The point to be found therefore, or that from which perpendiculars being drawn to the ſides of the figure, the ſum of their ſquares is the leaſt poſſible, is in the ſtraight line LC.

FOR let q be any point on either ſide of LC, and let the line ab be drawn through q parallel to AB, meeting LC in λ, then the ſum of the ſquares of the perpendiculars from q upon AC, CB, is greater than the ſum of the ſquares of the perpendiculars from λ upon the ſame lines. Therefore adding the ſquare of the perpendicular from q, or λ, on AB, to both, the ſum of the ſquares of the perpendiculars from q, will be greater than the

the ſum of the ſquares of the perpendiculars from λ. The point, therefore, which makes the ſum of the ſquares of the perpendiculars drawn from it, to the ſides of the triangle ABC, a *minimum*, is not on either ſide of the line LC; it is therefore in the line LC.

For the ſame reaſon, if AC be divided in L′, ſo that AL′ is to L′C as the ſquare of AB to the ſquare of BC, and if BL′ be joined, the point to be found is in BL′. It is therefore in the point Q, where the lines CL and BL′ interſect one another.

The point Q, in any other figure, may be found nearly in the ſame manner. Let ABCD, for inſtance, (fig. 9.) be a quadrilateral figure; let the oppoſite ſides, AB and DC, be produced till they meet in E, and let *ab* be drawn parallel to AB, meeting CE in *e*, and let λ be the point in the line *ab* from which perpendiculars are drawn to the three lines BC, CD, DA, ſo that the ſum of their ſquares is leſs, than if they were drawn from any other point, in the ſame line; then if weights be placed at *b*, *a* and *e*, proportional to the ſquares of the ſines of the angles C*ba*, *ba*D, *ae*D, λ is the centre of gravity of theſe weights. (§ 26.) Now, theſe weights having given ratios to one another, the *locus* of the point λ, from the known properties of the centre of gravity, is a ſtraight line Lλ, given in poſition. The point to be found is, therefore, in that line. For the ſame reaſon, it is in another ſtraight line L′λ′ alſo given in poſition; and therefore it is in Q, the point of their interſection.

There are many other remarkable properties of this point, which appear ſometimes in the form of Poriſms, and ſometimes of theorems. Of the former, ſome curious inſtances will be found in Dr Small's Demonſtrations of Dr Stewart's Theorems *. Of the latter, I ſhall only add one, omitting the demonſtration, which would lead into too long a digreſſion. "If Q be the point in a triangle from which perpendiculars are drawn to the ſides of the triangle, ſo that the ſum of their ſquares is the leaſt poſſible; twice the area of the triangle is a

 mean

* Tranſ. R. S. Edin. vol. ii. p. 112, &c.

mean proportional between the ſum of the ſquares of the ſides of the triangle, and the ſum of the ſquares of the above mentioned perpendiculars."

29. But to return to the ſubject of Poriſms: It is evident from what has now appeared, that in ſome inſtances at leaſt, there is a cloſe connection between theſe propoſitions and the *maxima* or *minima*, and, of conſequence, the impoſſible caſes, of problems. The nature of this connection requires to be further inveſtigated, and is the more intereſting, that the tranſition from the indefinite, to the impoſſible caſes of a problem ſeems to be made with wonderful rapidity. Thus, in the firſt propoſition, though there be not, properly ſpeaking, an impoſſible caſe, but only one where the point to be found goes off *ad infinitum*, we may remark, that if the given point F be any where out of the line HD, the problem of drawing GB equal to GF is always poſſible, and admits juſt of one ſolution; but if F be in the line DH, the problem admits of no ſolution at all, the point being then at an infinite diſtance, and therefore impoſſible to be aſſigned. There is however this exception, that if the given point be at K, in this ſame line DH, determined by making DK equal to DL, then every point in the line DE gives a ſolution, and may be taken for the point G. Here therefore the caſe of innumerable ſolutions, and the caſe of no ſolution, are as it were *conterminal*, and ſo cloſe to one another, that if the given point be at K, the problem is indefinite, but that if it remove ever ſo little from K remaining at the ſame time in the line DH, the problem cannot be reſolved.

I had obſerved this remarkable affinity between caſes, which in other reſpects are diametrically oppoſite, in a great variety of inſtances, before I perceived the reaſon of it, and found, that by attending to the origin which has been aſſigned to Poriſms, I ought to have diſcovered it *a priori*. It is, as we have ſeen, a general principle, that a problem is converted into a Poriſm, when one, or when two, of the conditions of it, neceſſarily involve in them ſome one of the reſt. Suppoſe then that two of the

the conditions are exactly in that ſtate, which determines the third; then, while they remain fixed or given, ſhould that third one be ſuppoſed to vary, or differ, ever ſo little, from the ſtate required by the other two, a contradiction will enſue. Therefore if, in the hypotheſis of a problem, the conditions be ſo related to one another as to render it indeterminate, a Poriſm is produced; but if, of the conditions thus related to one another, ſome one be ſuppoſed to vary, while the others continue the ſame, an abſurdity follows, and the problem becomes impoſſible. *Wherever therefore any problem admits both of an indeterminate, and an impoſſible caſe, it is certain, that theſe caſes are nearly related to one another, and that ſome of the conditions by which they are produced, are common to both.* This affinity, which ſeems to be one of the moſt remarkable circumſtances reſpecting Poriſms, will be more fully illuſtrated, when we treat of the algebraic inveſtigation of theſe propoſitions.

30. It is ſuppoſed above, that *two* of the conditions of a problem involve in them a third, and wherever that happens, the concluſion which has been deduced will invariably take place. But a Poriſm may ſometimes be ſo ſimple, as to ariſe from the mere coincidence of *one* condition of a problem with another, though in no caſe whatever, any inconſiſtency can take place between them. Thus, in the ſecond of the foregoing propoſitions, the coincidence of the point given in the problem with another point, *viz.* the centre of gravity of the given triangle, renders the problem indeterminate; but as there is no relation of diſtance, or poſition, between theſe points that may not exiſt, ſo the problem has no impoſſible caſe belonging to it. There are, however, comparatively but few Poriſms ſo ſimple in their origin as this, or that ariſe from problems in which the conditions are ſo little complicated; for it uſually happens, that a problem which can become indefinite, may alſo become impoſſible; and if ſo, the connection between theſe caſes, which has been already explained, never fails to take place.

31. Another

31. ANOTHER ſpecies of impoſſibility may frequently ariſe from the poriſmatic caſe of a problem, which will very much affect the application of geometry to aſtronomy, or any of the ſciences of experiment, or obſervation. For when a problem is to be reſolved by help of data furniſhed by experiment or obſervation, the firſt thing to be conſidered is, whether the data ſo obtained, be ſufficient for determining the thing ſought, and in this a very erroneous judgment may be formed, if we reſt ſatisfied with a general view of the ſubject: For though the problem may in general be reſolved from the data that we are provided with, yet theſe data may be ſo related to one another in the caſe before us, that the problem will become indeterminate, and inſtead of one ſolution, will admit of an infinite number.

SUPPOSE, for inſtance, that it were required to determine the poſition of a point F, (fig. 4.) from knowing that it was ſituated in the circumference of a given circle ABC, and alſo from knowing the ratio of its diſtances from two given points E and D; it is certain, that in general theſe data would be ſufficient for determining the ſituation of F: But nevertheleſs, if E and D ſhould be ſo ſituated, that they were in the ſame ſtraight line with the centre of the given circle: and if the rectangle under their diſtances from that centre, were alſo equal to the ſquare of the radius of the circle, then, as was ſhewn above, (§ 12.) the poſition of F could not be determined.

THIS particular inſtance may not indeed occur in any of the practical applications of geometry; but there is one of the ſame kind which has actually occurred in aſtronomy: And as the hiſtory of it is not a little ſingular, affording beſides an excellent illuſtration of the nature of Poriſms, I hope to be excuſed for entering into the following detail concerning it.

32. Sir ISAAC NEWTON having demonſtrated, that the trajectory of a comet is a parabola, reduced the actual determination

tion of the orbit of any particular comet, to the ſolution of a geometrical problem, depending on the properties of the parabola. but of ſuch conſiderable difficulty, that it is neceſſary to take the aſſiſtance of a more elementary problem, in order to find, at leaſt nearly, the diſtance of the comet from the earth, at the times when it was obſerved. The expedient for this purpoſe, ſuggeſted by NEWTON himſelf, was to conſider a ſmall part of the comet's path as rectilineal, and deſcribed with an uniform motion, ſo that four obſervations of the comet being made at moderate intervals of time from one another, four ſtraight lines would be determined, *viz.* the four lines joining the places of the earth and the comet, at the times of obſervation, acroſs which if a ſtraight line were drawn, ſo as to be cut by them into three parts, in the ſame ratios with the intervals of time above mentioned; the line ſo drawn would nearly repreſent the comet's path, and by its interſection with the given lines, would determine, at leaſt nearly, the diſtances of the comet from the earth, at the times of obſervation.

THE geometrical problem here employed, of drawing a line to be divided by four other lines given in poſition, into parts having given ratios to one another, had been already reſolved by Dr WALLIS and Sir CHRISTOPHER WREN, and to their ſolutions Sir ISAAC NEWTON added three others of his own, in different parts of his works. Yet none of all theſe geometers obſerved that peculiarity in the problem which rendered it inapplicable to aſtronomy. This was firſt done by M. BOSCOVICH, but not till after many trials, when, on its application to the motion of comets. it had never led to any ſatisfactory reſult. The errors it produced in ſome inſtances were ſo conſiderable, that ZANOTTI, ſeeking to determine by it the orbit of the comet of 1739, found, that his conſtruction threw the comet on the ſide of the ſun oppoſite to that on which he had actually obſerved it. This gave occaſion to BOSCOVICH, ſome years afterwards, to examine the different caſes of the problem, and

and to remark that, in one of them, it became indeterminate; and that, by a curious coincidence, this happened in the only cafe which could be fuppofed applicable to the aftronomical problem above mentioned; in other words, he found, that in the ftate of the data, which muft there always take place, innumerable lines might be drawn, that would be all cut in the fame ratio, by the four lines given in pofition. This he demonftrated in a differtation publifhed at Rome in 1749, and fince that time in the third volume of his *Opufcula*. A demonftration of it, by the fame author, is alfo inferted at the end of CASTILLON's Commentary on the *Arithmetica Univerfalis*, where it is deduced from a conftruction of the general problem given by Mr THOMAS SIMPSON, at the end of his Elements of Geometry*. The propofition, in BOSCOVICH's words, is this: "Problema quo quæritur recta linea quæ quatuor rectas pofitione datas ita fecet, ut tria ejus fegmenta fint invicem in ratione data, evadit aliquando indeterminatum, ita ut per quodvis punctum cujufvis ex iis quatuor rectis duci poffit recta linea, quæ ei conditioni faciat fatis †."

IT is needlefs, I believe, to remark, that the propofition thus enunciated is a Porifm, and that it was difcovered by BOSCOVICH, in the fame way, in which I have fuppofed Porifms to have been firft difcovered by the geometers of antiquity. I fhall add here a new analyfis of it, conducted according to the method of the preceding examples, and to which the following *lemma* is fubfervient.

LEMMA

* Elements, p. 243. Edit. 3. SIMPSON's folution is remarkably elegant, but no mention is made in it, of the indeterminate cafe.

† Jos. BOSCOVICH Opera, Baffani. tom. 3. p. 331.

LEMMA I. Fig. 10.

32. If two ſtraight lines, AE and BF, be cut by three other ſtraight lines, AB, CD and EF, given in poſition, and not all parallel to one another, into ſegments having the ſame given ratio, they will intercept between them ſegments of the lines given in poſition, *viz.* AB, CD, EF, which will alſo have given ratios to one another *.

PROP.

* Demonstration.—Through C and E draw CH and EG, both parallel to AB, and let them meet BG, parallel to AE, in H and in G. Let GF and HD be joined; and becauſe AC is to CE, that is, BH to HG as BD to DF, by hypotheſis, DH is parallel to GF, and has alſo a given ratio to it, *viz.* the ratio of GB to BH, or of EA to AC. Take GK equal to HD, and join EK, and the triangle EGK will be equal to the triangle CHD, and therefore the angle KEG is given, and likewiſe the angle KEF; and ſince the ratio of GK to KF is given, if from K there be drawn KL parallel to EG, meeting EF in L, the ratio of EL to LF will be given. But the ratio of EL to LK is given, becauſe the triangle ELK is given in ſpecies; therefore the ratio of FL to LK is given; and the angle FLK being alſo given, the triangle FKL is given in ſpecies, as alſo the triangle FGE. The angle FGE being therefore given, the triangle KGE is given in ſpecies, and EG has therefore given ratios to EK and EF. But EG is equal to AB, and EK to CD, therefore AB, CD and EF have given ratios to one another Q. E. D.

Hence to find the ratios of AB, CD and EF; in EF take any part EL, and make as AC is to CE, ſo EL to LF; through L draw LK parallel to EG or AB, meeting EK, drawn through E parallel to CD in K; then if FK be drawn meeting EG in G, the ratios required are the ſame with the ratios of the lines EG, EK, EF. This is evident from the preceding inveſtigation.

If it be required to find the poſition of the line AE, drawn through the point A, ſo as to be cut by CD and EF in a given ratio; draw A*c*, any how, cutting DC in *c*, and produce A*c* to *e*, ſo that A*c* may be to *c e* in the ratio which AC is to have to CE; let *e*E be drawn parallel to DC, interſecting FE in E, and if AE be joined, it is the line required.

Hence the converſe of the lemma is eaſily demonſtrated, *viz.* that if AE and BF be two lines that are cut proportionally by the three lines AB, CD, EF; and if AB and EF, the parts of any two of theſe laſt, intercepted between AE and BF, be alſo cut proportionally, any how, in *b* and *f*, and if *bf* be joined, meeting the third line in *d*, *bf* will be cut in the ſame proportion with AE or BF. For if not, let *bf'* be drawn from *b*, meeting CD in *d'*, and EF in *f'*, ſo that *bd'*:*d'f'*::AC:CE; then by the lemma, *ab*:AB:: E*f*:EF; and by ſuppoſition, *ab*:AB::E*f*:EF, therefore E*f'* = E*f*, which is impoſſible. Therefore, &c.

PROP. VI. PORISM. Fig. 11.

33. Three ſtraight lines being given in poſition, a fourth line, alſo given in poſition, may be found, ſuch, that through any point whatever a ſtraight line may be drawn, which will interſect theſe four lines, and will be divided by them into three ſegments, having given ratios to one another.

Let AB, CD, EF be the three lines given in poſition, and OL the line to be found, and $\alpha\delta$ a given line, of which the ſegments $\alpha\beta$, $\beta\gamma$, $\gamma\delta$ have given ratios to one another.

Let A be a given point in the line AB, and ſuppoſe, that AO is drawn from it, interſecting the lines CD, EF and OL in the points C, E and O, and divided at theſe points into the ſegments AC, CE, EO, having the ſame ratios to one another, with the given ſegments $\alpha\beta$, $\beta\gamma$, $\gamma\delta$ of the line $\alpha\delta$. Then, becauſe the lines CD, EF are given in poſition, and alſo the point A, the line AE is given in poſition and magnitude, (§ 32.) and therefore alſo EO, which has a given ratio to AE; the point O is therefore given.

Again, let B be any point whatever in AB, and let BL be drawn, according to the hypotheſis of the Poriſm, ſo as to be divided in the points D, F and L, where it interſects the lines CD, EF and OL into the parts, BD, DF and FL, having the ſame ratios with the parts $\alpha\beta$, $\beta\gamma$, $\gamma\delta$.

Let alſo BG be drawn equal and parallel to AE, and let EG be joined; EG will therefore be parallel to AB, and will be given in poſition; and if GF be drawn, it will make given angles with EG and EF, becauſe, by the preceding *lemma*, the ratio of AE to EF, that is, of EG to EF is given. Through L draw LN parallel to BG, meeting GF produced in N.

Then

Then becaufe the triangles BFG, LFN are fimilar, GF is to FN as BF to FL, that is, in a given ratio; and therefore, fince FG alfo makes given angles with the two ftraight lines EG and EF, given in pofition, the point N is in a ftraight line, given in pofition, and paffing through E, *viz.* EN.

Now, fince BF is to FL as BG to LN, and alfo as AE or BG to EO, LN and EO are equal, and being alfo parallel, OL is parallel to EN, that is, to a line given in pofition; and the point O, in OL, is given, therefore OL is given in pofition; which was to be found.

Conftruction. From any two given points, A and B′, in the line AB, draw AE and B′F′ interfecting CD and EF in C, E, D′ and F′, fo that AC may be to CE, and B′D′ to D′F′ in the fame given ratio of $\alpha\beta$ to $\beta\gamma$, (§ 32.) Produce alfo AE to O, and B′F′ to L′, fo that AE may be to EO, and B′F′ to F′L′ in the fame given ratio of $\alpha\gamma$ to $\gamma\delta$. If OL′ be joined, it will be the line required.

For let B be any point whatfoever in AB, and as AB′ to AB, fo let OL′ be to OL, and let BL be drawn, cutting CD′, and EF′ in D and F, the line BL is divided in thefe points, fimilarly to the given line $\alpha\delta$. For fince the two lines AO and B′L′ are divided fimilarly by the three lines AB′, CD′ and OL′, and fince two of thefe laft, AB′ and OL′, are alfo divided fimilarly to one another by the three lines AO, B′L′ and BL, BL will be divided in D, in the fame ratio wherein B′L′ is divided in D′, or AO in C, (Lem. 1. Conv.). In the fame way, BL is divided in F, in the fame ratio wherein AO is divided in E; BL is therefore fimilarly divided to AO, or to $\alpha\delta$, which was to be demonftrated.

34. Hence it is plain, " If two fimilarly divided lines, as AO and BL, be drawn any how, and if ftraight lines AB, CD, EF, OL, be drawn through the points of divifion of thefe lines, innumerable lines may be placed between the lines AB, CD, EF and OL, which will be divided by them, fimilarly to the lines AO, and BL." For, by what is here demonftrated, every line which cuts

any two of the lines AB, CD, &c. proportionally, will alſo cut the others proportionally, and will be cut by them into ſegments having the ſame ratio to one another, with the ſegments of the lines AO and BL.

From this it follows, that the aſtronomical problem, above mentioned, becomes a Poriſm, and is indeterminate, in the caſe when the obſervations of the comet are not very diſtant from one another. For on this ſuppoſition, the arches deſcribed by the earth, and by the comet during the time in which the obſervations are made, will not differ much from two ſtraight lines; and theſe lines will be divided ſimilarly to one another, becauſe each of them will be divided into parts, proportional to the intervals of time between the obſervations. The places of the earth, at the times of the obſervations, may therefore be nearly repreſented by the points A, C, E and O, in the ſtraight line AO, and thoſe of the comet by the points B, D, F and L, in the ſtraight line BL, theſe lines AO and BL being divided both into parts having the ſame ratios. The poſition of BL therefore is not given, ſince, by the Poriſm, it may be any line whatever, which cuts the two lines, AB and OL, in a certain ratio.

It is alſo to be remarked, that in order to render this, or any other geometrical problem, of no uſe in queſtions where the data are furniſhed by obſervation, and are conſequently liable to ſome inaccuracy, it is not neceſſary, that the problem ſhould be reduced exactly to the poriſmatic caſe; for even on a near approach to that caſe, a very ſmall error in the data will produce ſo great an error in the concluſion, that no dependence can be had upon its accuracy.

This will be made evident in the preſent inſtance, by conſidering how the conſtruction of the Poriſm is ſubſervient to the ſolution of the other caſes of the problem. Suppoſe that four lines, AB, CD, EF, RS, (fig. 11.) are given in poſition, and that it is required to draw a ſtraight line that ſhall be divided by theſe lines into parts having the ratios of the given lines $\alpha\beta$, $\beta\gamma$, $\gamma\delta$.

Let

Let KT be that line, and aſſuming the points A and B′, and drawing the lines AO, B″L, ſo that they may be ſimilarly divided to the line $\alpha\delta$, as in the conſtruction of the Poriſm, then if OL be joined, it will be given in poſition, and the extremity K, of the line KT, will be in the line OL, by the Poriſm; but it is alſo in the line RS; it is therefore given. Now, by the *lemma*, AT is to TB′ as OK to KL′, and the lines OK and KL′ being given, the ratio of AT to TB′ is given, ſo that T is given, and therefore TK is given in poſition. Q. E. I.

Now, it is evident, that if RS make a ſmall angle with OL, any error in the determination of that angle will make a great variation in the poſition of the point K. A ſmall change in it may, for inſtance, make RS parallel to OL, and conſequently will throw off K, to an infinite diſtance, ſo that the line, which is ſought, will be impoſſible to be found; and in general, the variation of the poſition of K, correſponding to a given variation in the angle RKO, will be, *cæteris paribus*, inverſely as the ſquare of the ſine of that angle. The nearer, therefore, that the problem is to the Poriſm, the leſs is the ſolution of it to be depended on, and the more does it partake of the indefinite character of the latter.

35. Sir Isaac Newton has extended the hypotheſis of the problem from which the preceding Poriſm is derived, and has formed from it one more general, which he has alſo reſolved, with a view to its application in aſtronomy. It is this: "To "deſcribe a quadrilateral, given in ſpecies, that ſhall have its "angles upon four ſtraight lines given in poſition *."

As it is evident, that the former problem is but a particular caſe of this laſt, it is natural to expect, that a Poriſm is alſo to be derived from it, or that the lines given in poſition may be ſuch, that the problem will become indeterminate. On attempting the analyſis, I have accordingly found this conjecture verified;

* Prin. Math. lib. 1. lem. 27.

fied; the inveſtigation depending on a *lemma* ſimilar to that which is prefixed to the preceding propoſition.

LEMMA II. FIG. 12.

IF two triangles ABC, DEF, ſimilar to a given triangle, be placed with their angles on three ſtraight lines given in poſition, ſo that the equal angles in both the triangles may be upon the ſame ſtraight lines, the ratios of the ſegments of theſe ſtraight lines, intercepted between the two triangles, that is, of AD, BE and CF, are given *.

PROP.

* DEMONSTRATION.—Complete the parallelogram under AC and AD, *viz.* AG, and on DG deſcribe the triangle DGH, ſimilar and equal to the triangle ABC. Join FG, BH and HE. Through G alſo, draw GK, equal and parallel to HE, and join CK; CK will be equal and parallel to BE, and the triangle CGK equal to the triangle BHE. The angle GCK is therefore given, being equal to the given angle HBE; and the angle GCF being given, the angle FCK is alſo given.

THE triangles DHE, DGF are ſimilar; for the angles FDE, GDH being equal, the angles FDG, EDH are likewiſe equal; and alſo, by ſuppoſition, FD being to DE as GD to DH, FD is to DG as DE to DH. The angle FGD is therefore equal to the angle EHD, and FG is alſo to EH, or to KG, as FD to DE, or as GD to DH.

BUT if GL be drawn parallel to HD, the angle KGL will be equal to the angle EHD, that is, to the angle FGD, and therefore the angle KGF to the angle LGD or GDH; and it has been ſhewn, that FG is to GK as GD to DH; therefore the triangle FGK is ſimilar to the triangle GDH, and is given in ſpecies.

DRAW GM perpendicular to CF, and GN making the angle MGN equal to the angle FGK or GDH, and let GM be to GN in the given ratio of FG to GK, or of GD to DH. Join CN and NK. Then, becauſe MG:GN::FG:GK, MG:FG::GN:GK; and the angle MGF being equal NGK, the triangles MGF, NGK are ſimilar, and therefore GNK is a right angle. But ſince the ratio of MG to GN is given, and alſo of MG to GC, the triangle CGM being given in ſpecies, the ratio of GC to GN is given, and CGN being alſo a given angle, becauſe each of the angles CGM, MGN is given, the triangle CGN is given in ſpecies, and conſequently the ratio of CG to CN is given. The angle NCK is therefore given; and the angle CNK is likewiſe given, each of the angles CNG, GNK being given, therefore the triangle CNK is alſo given in ſpecies. The ratio of CN to CK is therefore given, and ſince the ratio of CN to CG is alſo given, the ratio of CG to CK

is

PROP. VII. PORISM. Fig. 13.

36. Three ſtraight lines being given in poſition, a fourth may be found, which will alſo be given in poſition, and will be ſuch, that innumerable quadrilaterals, ſimilar to the ſame given quadrilateral, may be deſcribed, having their angles placed, in the ſame order, on the four ſtraight lines given in poſition.

Let AD, BE, CF be the three ſtraight lines given in poſition, and *ablc* a given quadrilateral. Let A be a given point in the line AD, and let ABLC be a quadrilateral, ſimilar to the given quadrilateral *ablc*, placed, ſo that the angles of the triangle ABC, ſimilar to the given triangle *abc*, may be, one of them, at the given point A, and the other two, on the lines BE and CF. The points B and C, and the triangle ABC, will therefore be given, (Lemma 2. Cor.) and conſequently the triangle CBL will alſo be given in poſition and magnitude, and the point L will be given. The line to be found muſt paſs through L; let it be LM; let M be any point in it whatſoever, and let MEDF be a quadrilateral ſimilar to the given quadrilateral *ablc*, having its angles on the four lines LM, CF, BE and AD, the angle at M being equal to the angle CLB, *&c.*

Complete the parallelogram AG, under CA, AD, and on DG deſcribe the quadrilateral GDHN, ſimilar and equal to the quadrilateral

is given, and the triangle CGK given in ſpecies. The angle KGC is therefore given, and the angle KGF being alſo given, the angle CGF is given, and conſequently the ratio of CG to CF. The ratios of the lines CG, CK and CF to one another, that is, of AD, BE and CF to one another, are therefore given. Q. E. D.

Cor. Hence alſo it appears, how a triangle given in ſpecies may be deſcribed, having its angles on three ſtraight lines given in poſition, and one of the angles at a given point in one of the lines. The ſolution of this problem is therefore taken for granted, in the analyſis of the Poriſm, though, for the ſake of brevity, the conſtruction is omitted.

drilateral ABLC; join BH and LN, and it is evident, that the three lines CG, BH and LN are all equal, and parallel to AD, and are all given in poſition. Join alſo AL, DN, DM, MN and FG.

Because the two quadrilaterals DEMF, DHNG are ſimilar, the angle FDM is equal to the angle GDN, and therefore the angle GDF to the angle NDM. For the ſame reaſon alſo, GD : DF : : ND : DM, and therefore the triangles GDF, NDM are ſimilar, and the angle FGD equal to the angle MND, and FG : MN : : GD : DN, ſo that FG has a given ratio to MN.

But becauſe the triangles ABC, DEF are ſimilar, CG has a given ratio to CF, (Lem. 2.) ſo that the angle GCF being given, the triangle CGF is given in ſpecies, and FG has to GC a given ratio; now, FG was alſo ſhewn to have to MN a given ratio; therefore MN has a given ratio to CG, that is, to LN.

Again, ſince the triangle CGF is given in ſpecies, the angle CGF is given, and CGD being alſo a given angle, the angle FGD is given, and therefore MND, which is equal to it. But the angle LND is given, therefore the angle LNM is given; and it was ſhewn, that MN has a given ratio to NL, therefore the angle MLN is given; now, the point L, and the line LN, are given in poſition; therefore LM is alſo given in poſition, which was to be found.

The conſtruction for finding LM is obvious. Take A and D, two given points in one of the lines given in poſition, and place the two triangles ABC, DEF ſimilar to the given triangle *abc*, ſo that two of their equal angles may be at A and D, and the other equal angles on the lines BE and CF, (Lem. 2. Cor.). On BC and EF, deſcribe the triangles BLC, FEM, ſimilar to the triangle *cbl;* if LM be drawn, it will be the line required.

From the analyſis it alſo follows, that the quadrilaterals deſcribed with their angles on the four ſtraight lines given in poſition, as ſuppoſed in the Poriſm, will intercept between them ſegments of theſe lines, having given ratios to one another.

37.

37. THIS Porifm may alfo be extended to figures of any number of fides, and may be enunciated more generally thus: " A rectilineal figure of any number of fides, as *m*, being given, and three ftraight lines being alfo given in pofition, *m*—3 ftraight lines may be found given in pofition, fo that innumerable rectilineal figures may be defcribed, fimilar to the given rectilineal figure, and having their angles on the ftraight lines given in pofition."

HENCE alfo this theorem: " If any two rectilineal figures be defcribed fimilar to one another, and if ftraight lines be drawn, joining the equal angles of the two figures, innumerable rectilineal figures may be defcribed, which will have their angles on thefe lines, and will be fimilar to the given rectilineal figures; and the fegments of the lines given in pofition, intercepted between any two of thefe figures, will have conftantly the fame ratio to one another."

As a *Locus*, the fame propofition admits of a very fimple enunciation, and has a remarkable affinity to that with which EUCLID appears to have introduced his firft book of Porifms. " If three of the angles of a rectilineal figure, given in fpecies, be upon three ftraight lines given in pofition, the remaining angles of the figure will alfo be on ftraight lines, given in pofition."

IF the rectilineal figures here referred to be fuch, as may be infcribed in a circle, or in fimilar curves of any kind, agreeably to the hypothefis of the problem *, by which thefe laft Porifms were fuggefted, we fhall have a number of other Porifms refpecting ftraight lines given in pofition, which cut off, from innumerable fuch curves, fegments that are given in fpecies. A great field of geometrical inveftigation is, therefore, opened by the two preceding propofitions, which, however, we muft at prefent be content to have pointed out.

38. A QUESTION nearly connected with the origin of Porifms ftill remains to be refolved, namely, from what caufe

 has

* Prin. Math. lib. 1. prop. 29.

has it arisen, that propositions which are in themselves so important, and that actually occupied so considerable a place in the ancient geometry, have been so little remarked in the modern? It cannot indeed be said, that propositions of this kind were wholly unknown to the moderns before the restoration of what EUCLID had written concerning them; for beside M. BOSCOVICH's proposition, of which so much has been already said, the theorem which asserts, that in every system of points there is a centre of gravity, has been shewn above to be a Porism; and we shall see hereafter, that many of the theorems in the higher geometry belong to the same class of propositions. We may add, that some of the elementary propositions of geometry want only the proper form of enunciation to be perfect Porisms. It is not therefore strictly true, that none of the propositions called Porisms have been known to the moderns; but it is certain, that they have not met, from them, with the attention they met with, from the ancients, and that they have not been distinguished as a separate class of propositions. The cause of this difference is undoubtedly to be sought for in a comparison of the methods employed for the solution of geometrical problems in ancient, and in modern times.

IN the solution of such problems, the geometers of antiquity proceeded with the utmost caution, and were careful to remark every particular case, that is to say, every change in the construction, which any change in the state of the data could produce. The different conditions from which the solutions were derived, were supposed to vary one by one, while the others remained the same; and all their possible combinations being thus enumerated, a separate solution was given, wherever any considerable change was observed to have taken place.

This was so much the case, that the *sectio rationis*, a geometrical problem of no great difficulty, and one of which the solution would be dispatched, according to the methods of the modern geometry, in a single page, was made, by APOLLO-

NIUS,

NIUS, the ſubject of a treatiſe conſiſting of two books. The firſt book has ſeven general diviſions, and twenty-four caſes; the ſecond, fourteen general diviſions, and ſeventy-three caſes, each of which caſes is ſeparately conſidered. Nothing, it is evident, that was any way connected with the problem, could eſcape a geometer, who proceeded with ſuch minuteneſs of inveſtigation.

THE ſame ſcrupulous exactneſs may be remarked in all the other mathematical reſearches of the ancients; and the reaſon doubtleſs is, that the geometers of thoſe ages, however expert they were in the uſe of their analyſis, had not ſufficient experience in its powers, to truſt to the more general applications of it. That principle which we call the *law of continuity*, and which connects the whole ſyſtem of mathematical truths by a chain of inſenſible gradations, was ſcarcely known to them, and has been unfolded to us, only by a more extenſive knowledge of the mathematical ſciences, and by that moſt perfect mode of expreſſing the relations of quantity, which forms the language of algebra; and it is this principle alone which has taught us, that though in the ſolution of a problem, it may be impoſſible to conduct the inveſtigation without aſſuming the data in a *particular* ſtate, yet the reſult may be perfectly *general*, and will accommodate itſelf to every caſe with ſuch wonderful verſatility, as is ſcarcely credible to the moſt experienced mathematician, and ſuch as often forces him to ſtop, in the midſt of his calculus, and to look back, with a mixture of diffidence and admiration, on the unforeſeen harmony of his concluſions. All this was unknown to the ancients; and therefore they had no reſource, but to apply their analyſis ſeparately to each particular caſe, with that extreme caution which has juſt been deſcribed; and in doing ſo, they were likely to remark many peculiarities, which more extenſive views, and more expeditious methods of inveſtigation, might perhaps have induced them to overlook.

39. To reſt ſatisfied, indeed, with too general reſults, and not to deſcend ſufficiently into particular details, may be conſidered

 as

as a vice that naturally arifes out of the excellence of the modern analyfis. The effect which this has had, in concealing from us the clafs of propofitions we are now confidering, cannot be better illuftrated than by the example of the Porifm difcovered by BOSCOVICH, in the manner related above. Though the problem from which that Porifm is derived, was refolved by feveral mathematicians of the firft eminence, among whom alfo was Sir ISAAC NEWTON, yet the Porifm which, as it happens, is the moft important cafe of it, was not obferved by any of them. This is the more remarkable, that Sir ISAAC NEWTON takes notice of the two moft fimple cafes, in which the problem obvioufly admits of innumerable folutions, *viz.* when the lines given in pofition are either all parallel, or all meeting in a point, and thefe two hypothefes he therefore exprefsly excepts. Yet he did not remark, that there are other circumftances which may render the folution of the problem indeterminate, as well as thefe ; fo that the porifmatic cafe confidered above, efcaped his obfervation : And if it efcaped the obfervation of one who was accuftomed to penetrate fo far into matters infinitely more obfcure, it was becaufe he fatisfied himfelf with a general conftruction, without purfuing it into its particular cafes. Had the folution been conducted after the manner of EUCLID or APOLLONIUS, the Porifm in queftion muft infallibly have been difcovered.

BUT I have already extended this paper to too great a length ; fo that, leaving the ufe of algebra in the inveftigation of Porifms, to be treated of on another occafion, I fhall conclude with a remark from PAPPUS, the truth of which, I would willingly flatter myfelf, that the foregoing obfervations have had fome tendency to evince : " Habent autem Porifmata fubtilem " et naturalem contemplationem, neceffariam et maxime uni- " verfalem, atque iis, qui fingula perfpicere et inveftigare valent, " admodum jucundam."

VIII.

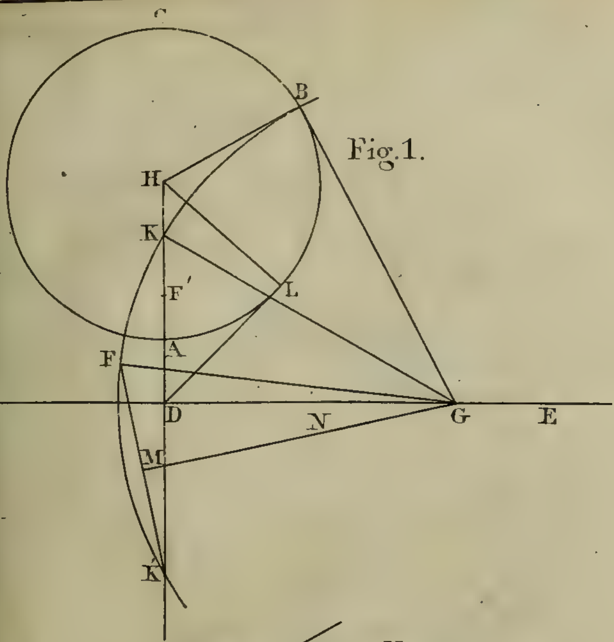


Fig. 1.

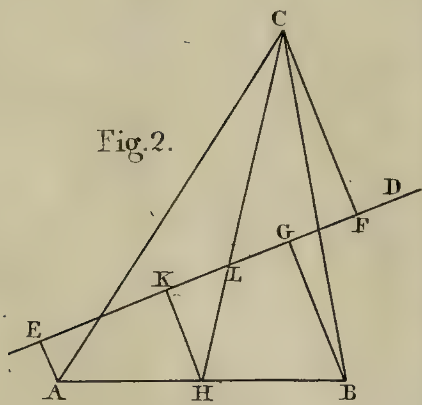


Fig. 2.

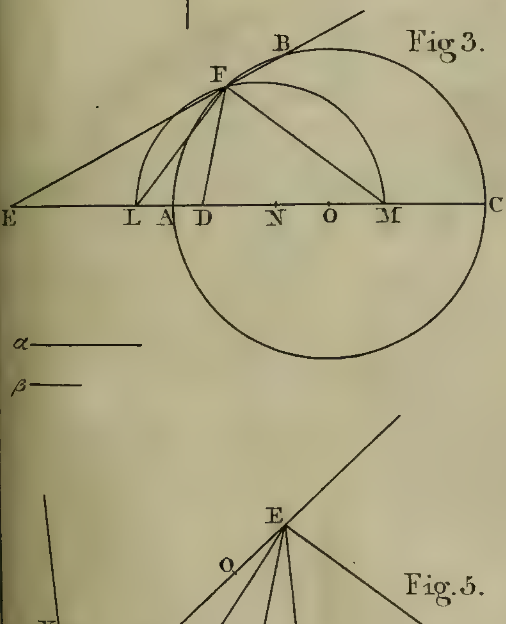


Fig. 3.

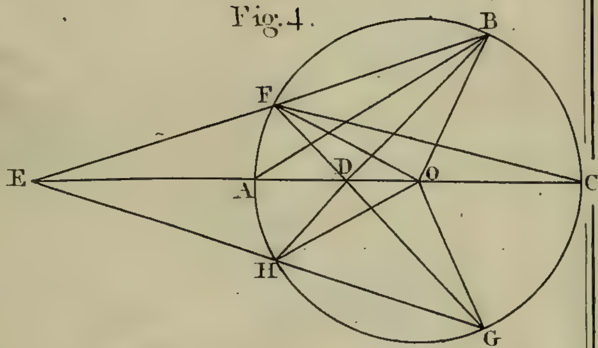


Fig. 4.

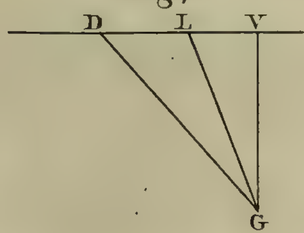


Fig. 7.

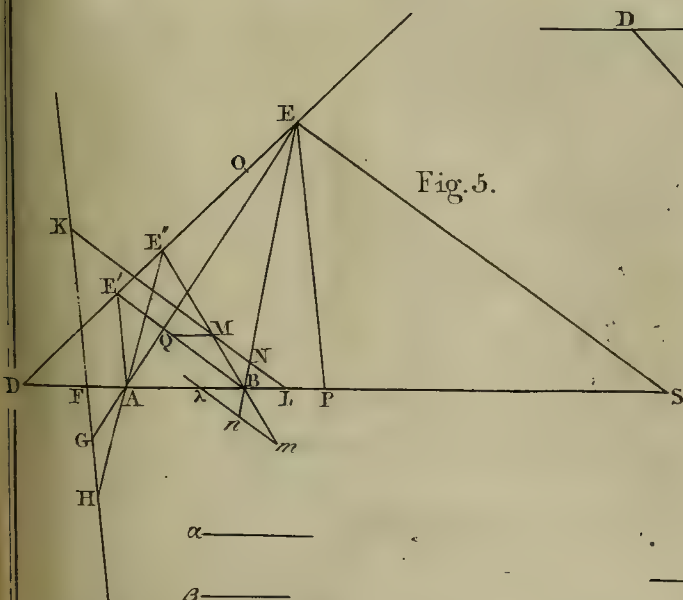


Fig. 5.

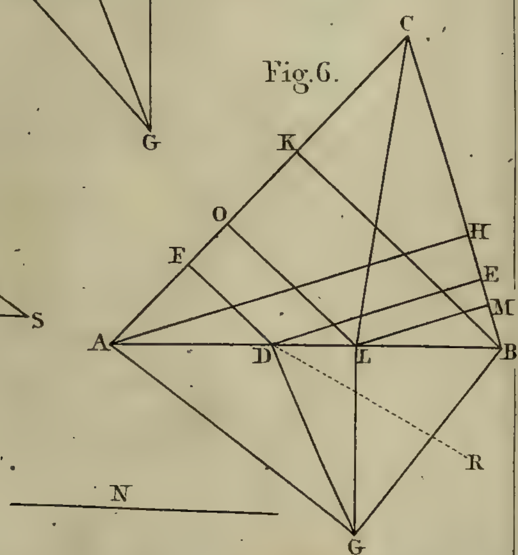


Fig. 6.

Fig. 10.

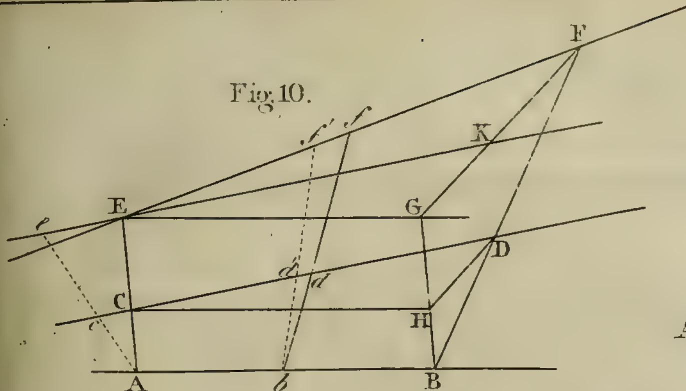


Fig. 8.

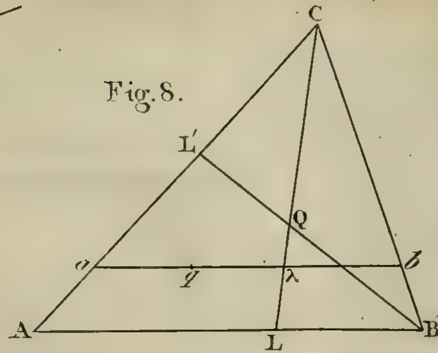


Fig. 11.

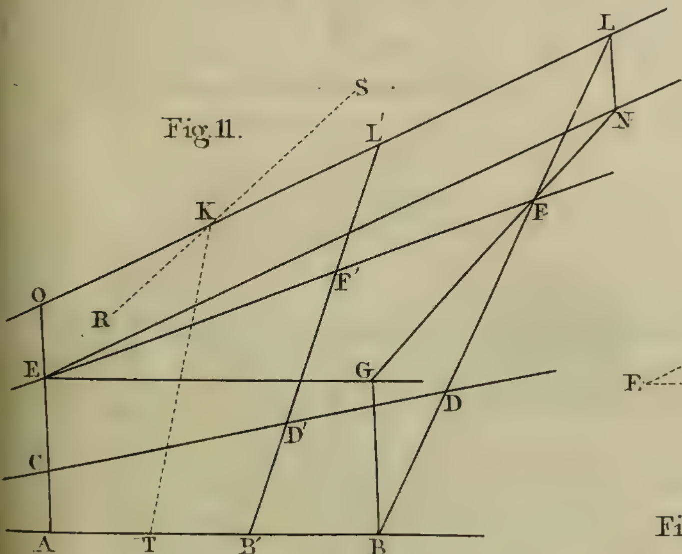


Fig. 9.

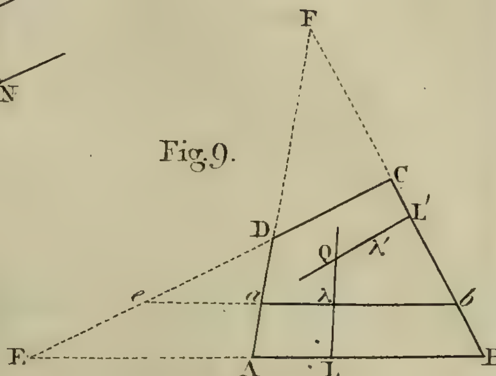


Fig. 13.

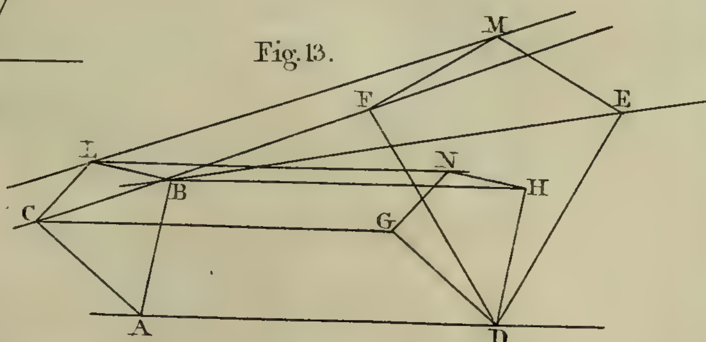
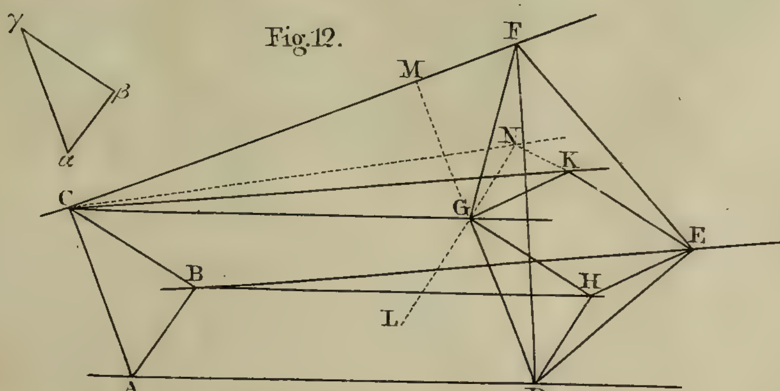


Fig. 12.



VIII. *An* Account *of the QUASSIA POLYGAMA, or* Bitter-Wood *of Jamaica; and of the CINCHONA BRACHYCARPA, a new Species of* Jesuit's Bark *found in the ſame Iſland. By Mr* John Lindsay, *Surgeon in Weſtmoreland, Jamaica.*

[*Read Nov.* 7. 1791.]

THE *Quaſſia Polygama* has long been known in Jamaica, and in ſome other iſlands in the Weſt Indies, not only as an excellent timber, but as an uſeful medicine in putrid fevers and fluxes. With us, it is called *Bitter-wood*, and in the Windward Iſlands, the *Bitter Aſh*. The bark has for ſome time been preſcribed by practitioners here, and exported to England in conſiderable quantities, for the purpoſes of the brewers of ale and porter. On theſe accounts, a fuller deſcription of this plant than has hitherto appeared, will be acceptable to the botaniſt and the public at large.

Previous to this, it will be proper to give a ſhort hiſtorical account of this tree from preceding writers.

Sir Hans Sloane, who called at Barbadoes, notices the *Bitter-wood*. In his catalogue, he deſcribes it thus: " Milanomma " et melanoxylum, arbor laurifolia nucifera, *gemmis nigricanti-* " *bus*, Americana." He refers to Plukenet, Tab. 205. fig. 3.; but that plant is different from ours, and probably he meant another, which we ſhall have occaſion to mention preſently.

Dr

Dr Patrick Browne, and after him Mr Long, in their Hiſtories of Jamaica, mention this tree by the names of *Xylopicrum*, *Xylopia glabra*, *Bitter-wood* or *Bitter Aſh*. Mr Long, in ſpeaking of the *Quaſſia Amara*, thinks the Bitter Aſh of St Chriſtopher's is the ſame, but does not ſeem to know whether the Bitter Aſh has been found in Jamaica.

Dr William Wright, F. R. S. of London, Edinburgh, &c. in his Account of the Medicinal Plants growing in Jamaica *, mentions this tree under the title of *Picrania Amara*, a new genus belonging to the claſs *Pentandria Monogynia*, and ſays it is uſed in putrid fevers as an antiſeptic, and that leſs of it will do, than of the *Quaſſia Amara* of Surinam. Dr Wright was naturally led to place this tree in the claſs and order he has done, from finding hermaphrodite flowers and ſeeds on the ſame tree; at the ſame time he remarks, that this tree has a great affinity to the genus Quaſſia.

Dr Olaaf Swartz examined moſt of the plants in Jamaica and the other iſlands. He probably had ſeen the ſame tree in flower and fruit, and in his Prodromus, he ſtyles it, "*Quaſſia* "*Excelſa*, floribus hermaphroditis 5dris paniculatis, foliis im-"pari-pinnatis, foliolis oppoſitis petiolatis, petiolo nudo."

No other particular deſcription of this tree has yet appeared; and as both bark and wood may be in more general uſe, I have taken ſome pains to examine this new ſpecies, and I hope the following account of it will enable the botaniſt, or any other, to find it. I have, however, given a drawing of the leaves and fructification, which will put every thing out of doubt.

The Quaſſia Polygama is a very common tree in moſt of our woodlands. It is beautiful, tall and ſtately. I have meaſured one, which was 100 feet in length, and ten feet in circumference,

* London Medical Journal, part III. for 1787.

rence, eight feet above the ground. The trunk is ſtraight, ſmooth and tapering, ſending off its branches towards the top.

THE outſide bark is pretty ſmooth, of a light gray or aſh colour, from various lichens. The bark of the roots is of a yellow caſt, ſomewhat like the Cortex Simaruba. The inner bark is tough, and compoſed of fine flaxy fibres.

THE wood is of a yellow colour, tough, but not very hard. It takes a good poliſh, and is uſed as flooring.

THE leaves are ſub-alternate; the ſmall leaves are in pairs, from five to eight, ſtanding oppoſite to each other on ſhort foot-ſtalks, and ending with an odd one. They are of an oblong oval ſhape, and pointed; the ribs reddiſh, and the young leaves are covered with a fine browniſh down. The flowers come out in bunches or cluſters from the lower part of the laſt ſhoot before the leaves, and ſtand on round foot-ſtalks. The flowers are ſmall, of a yellowiſh green colour, with a very ſmall calyx. The male or barren tree has flowers nearly ſimilar to the hermaphrodite, but in it there are only the rudiments of a ſtyle.

THE fruit is a ſmooth black *drupa*, round ſhaped, and of the ſize of a pea. There is but little pulp, and the nut covers a round kernel. Theſe *drupæ* are generally three, ſometimes two, and often only one, attached ſideways to a roundiſh fleſhy receptacle. It flowers in October and November, and its fruit is ripe in December and January.

EXCEPT the pulp of the fruit, every other part of this tree has an intenſely bitter taſte. From this quality, Sir JOSEPH BANKS, Dr SOLANDER, and Dr WRIGHT in the paper above mentioned, gave it the name of *Picrania Amara*. In taſte and virtues, it is nearly equal to the *Quaſſia* of Surinam, and I am credibly informed, is ſold in London for the *Quaſſia Amara*, and it may be ſafely uſed in all caſes where that drug has been thought proper, whether as an antiſeptic, or in caſes of weak-

neſs

nefs in the ftomach and bowels. It may either be given alone, or joined with the Jefuit's bark.

I HAVE feen the happieft effects from the ufe of this medicine in obftinate remitting fevers from marfh miafmata, in agues which had refifted the ufe of Jefuit's bark, and in dyfenteries of long ftanding. It is in daily practice in dropfies from debility, either in fimple infufions or tincture by itfelf, or joined with aromatics and chalybeates.

Dr DRUMMOND, an eminent Phyfician here, prefcribes it with great fuccefs in the above cafes, as well as in amenorrhæa, chlorofis, dyfpepfia, and in that fpecies of pica called *Dirt-eating*, fo fatal to a number of negroes.

THE bark of the Quaffia Polygama, but efpecially the wood, is intenfely bitter. I have ufed both in various forms.

THE bark is difficult to be reduced to powder. The dofe is from 15 grains to 1 dram, either by itfelf, or joined to the Jefuit's bark.

ʒii, ʒiii, or ℥fs of the bark or wood to 1 lb. watery infufion.

THE fame quantities to decoction from $1\frac{1}{2}$ lb. water to 1 lb. The dofe is a wine-glafs full every three, four or fix hours, according to circumftances.

IN certain cafes of dropfy, aromatics and preparations are joined to it, alfo in amenorrhæa and chlorofis; and in worm fevers, the cabbage bark, or other vegetable anthelmintics.

Linnæan

Linnæan Deſcription of the Quaſſia Polygama.

ARBOR excelſa ſæpe centum pedes alta. *Caudex* ſpectabilis, erectus, glaber. *Cortex* cinereus in Epidermide, interne albido flaveſcens, tenax et ex fibris lentis confectus. *Ramuli* alterni teretes.

Folia ſub-alterna. *Foliola* 5—10 jugata impari-pinnata, oppoſita, oblonga, obtuſe-acuminata, glabra, integerrima, venoſa, breviter petiolata. *Petiolus communis* ſubtus nudus. *Stipulæ* laterales parvæ, lanceolatæ, erectæ, deciduæ.

Infloreſcentia cymoſa. *Pedunculi* ſolitarii, teretes, plerumque nudi, in plurimos ramulos diviſi.

FLOS MASCULUS.

Cal. Perianthium, inferum, minimum, ex ſquamulis quatuor compoſitum. *Foliolis* ovatis perſiſtentibus.

Cor. Petala 4, oblonga, obtuſa, æqualia, ſeſſilia, ſuberecta. *Nectarium* ex ſquamis 4 ovatis, villoſis, baſi filamentorum interiori inſertis.

Stam. filamenta 4, 5, 6, filiformia, ſuberecta, æqualia, corolla longiora, receptaculo inſerta. *Antheræ* ſimplices erectæ.

FLOS HERMAPHRODITUS *in diverſa Arbore.*

Cal. et *Cor.* ut in mare.

Stam. ut in mare, ſed filamenta corollam vix ſuperant.

Piſt. Receptaculum carnoſum, orbiculatum, elevatum, germine latius. *Germen* ſubovatum, ex duobus, tribus, raro quatuor compoſitum, leviter coherentibus. Styli craſſiuſculi, erecti. Stigmata 2, 3, 4, ſimplicia, declinata.

Per. Drupæ 2, 3, 4, globoſæ, laterales, diſtantes, nigerrimæ, nitentes, receptaculo inſertæ.

Sem. Solitaria globoſa, unilocularia, nauco fragili tecta.

EXPLANATION OF PLATE I.

FIG. 1. reprefents a branch of the male tree in flower, rather under the natural fize.

2. A male flower complete, and of the natural fize.

3. The fame magnified.

4. The ftamina in their natural fituation magnified, and in the receptacle fomewhat depreffed.

5. A fingle ftamen magnified.

6. A petal magnified.

7. The fame of a natural fize.

8. A hermaphrodite flower of the natural fize.

9. The fame magnified.

10. The piftillum magnified with the fquamæ of the calyx; the three germina, ftyli and ftigmata, in their natural fituation.

11. The three drupæ or ripe fruit, of their natural fize and fituation.

12. The receptacle of its ufual fize.

13. One of the drupæ of ditto.

14. A tranfverfe fection of the fruit.

An

An Account of the CINCHONA BRACHYCARPA, *a new Species of Jesuit's Bark, growing in Jamaica.*

THIS tree was first discovered in November 1784, on the north-east side of the hill that overlooks the works of *Mountain Spring estate*, in the parish of Westmoreland, and afterwards on some of the mountains near the *Moreland estates* in the same parish. As it has hitherto been unknown to naturalists, I purpose to give a botanical account of it, and afterwards its qualities and medical effects. The better to illustrate my meaning, I sent a drawing of this new plant *, with the fructification, to my late excellent friend Dr HOPE, who wrote me he would lay my paper before the Royal Society of Edinburgh. His death happened soon after, and prevented his intentions.

PENTANDRIA MONOGYNIA.

Cal. Perianthium monophyllum, superum, campanulatum, parvum, 5 dentatum, persistens, dentibus acutis, erectis.

Cor. Monopetala, infundibuliformis. *Tubus* cylindraceus longissimus. *Laciniis*, angusto oblongis, patente revolutis.

Stam. Filamenta 5, interdum sex, filiformia, tubo longiora, in fauce tubi inserta. *Antheræ* lineares erectæ.

Pist. Germen ovatum, inferum. Stylus filiformis longitudine staminum. Stigma crassiusculum ovatum simplex.

Per. Capsula oblongo-ovata magna, calyce coronata, bipartibilis, dehiscens in duas partes interius dehiscentes, dissepimento parallelo.

 Semina

* The drawing alluded to cannot now be found. The figure annexed was taken from a dried specimen in the Herbarium of Dr WRIGHT, who saw the plant, in full flower and fruit, in 1785. Vid. Pl. II.

Semina plurima, parva, compreſſa, marginata.

Arbor erecta 20 pedes alta, ramis patentibus. Cortex fuſco-cinereus, ſapore primo dulci, mox amareſcente.

Folia oppoſita, oblongo ovata, integerrima, glabra, ſubtus venoſa, petiolata. Petioli breves, ſupra ſulcati. *Stipulæ* laterales, ovato-lanceolatæ, integræ, caulem arcte amplexantes.

Infloreſcentia paniculato-corymboſa, terminalis. *Pedunculus* plerumque brachiato-triternatus, teres, nudus. *Corolla* glabra, palide rubra vel carnea, tres circiter polices longa.

I HAVE only met with this tree in three places; in the inland, woody and mountainous parts of Weſtmoreland and Hanover pariſhes. It grew on rocky ground, with a brick mould, and affecting a northern aſpect. The talleſt I ever ſaw was about thirty feet high, and 7 or 8 inches in diameter. The *branches* are few and ſpreading. The *leaves* ſtand in pairs; they are ſmooth and ſhining; they are very like thoſe of the *Portlandia grandiflora*. The *flowers* grow in pretty large cluſters, on the extremities of the branches; and have nearly the beauty and appearance of the common *honey-ſuckle*, but are rather larger.

THE *ſeed-pod* is larger than any other of this genus. It is oval, adorned with the calyx, of a firm conſiſtence, ſomewhat ſtriated, and black-coloured; when ripe, it ſplits in two, and diſcharges a number of ſmall, flat, brown ſeeds, with a membrane nearly round the edges.

THE trunk and branches are of a browniſh gray colour, with a few ſuperficial furrows, and croſs cracks like the Peruvian bark. The bark of the trunk is pretty thick, and when wounded, exſudes a ſmall quantity of a milky juice. The bark, when dried, is of a purpliſh brown colour on the inſide. It is fibrous, and more difficult to pulveriſe than the Jeſuit's bark in uſe. The powder is of a purpliſh gray colour, and taſtes ſweet, then bitter and aſtringent.

No

No opportunity ought to be omitted that can in any way make us more acquainted with this valuable genus *Cinchona*, the ſalutary effects of which give a ſecurity and comfort to the lives of thoſe, in warm and unhealthy climates, beyond any other medicine we know of. This ſpecies might be uſed as a ſubſtitute to the Peruvian bark; but it is to be regreted, that the tree is ſcarce and ſmall, and that enough of it cannot be had, at leaſt in theſe parts *.

I DO not pretend to hold up this new bark as ſuperior, or even equal to the Peruvian. I have given it in the ſlighter caſes of intermitting and remitting fevers, with good effect; and in a few inſtances, it produced a cure, where the patients had taken the common and red bark to no purpoſe.

TO people afflicted with intermittents, I gave of the powder from twelve grains to thirty every hour, or every two hours in the abſence of fever. By this means, a ſtop was put to the fever, and the patients recovered. I have alſo adminiſtered this new bark in dyſpepſia, both in powder and infuſion. It ſat eaſy on the ſtomach, promoted appetite, and was eaſy to take. I had ſhewn this ſpecies of *Cinchona* to my good friend Dr WRIGHT, before he left the iſland, and gave him a little of the bark. He gave it in powder to a patient, but found it emetic, which could only happen from ſome peculiarity in the conſtitution †. In his letter to me, he intimates, that probably the ſame thing would happen, with every other of this genus, if given before it was completely dried.

Of

* This loſs may be compenſated by the abundance of the Cinchona Caribæa ſeu Jamaicenſis, deſcribed by Dr WRIGHT in the 67th vol. of Phil. Tranſ. and which, we are aſſured, has been found to anſwer all the purpoſes of the Cinchona Officinalis.

† See Dr WRIGHT's Account of the Medicinal Plants growing in Jamaica, London Medical Journal, part iii. for 1787.

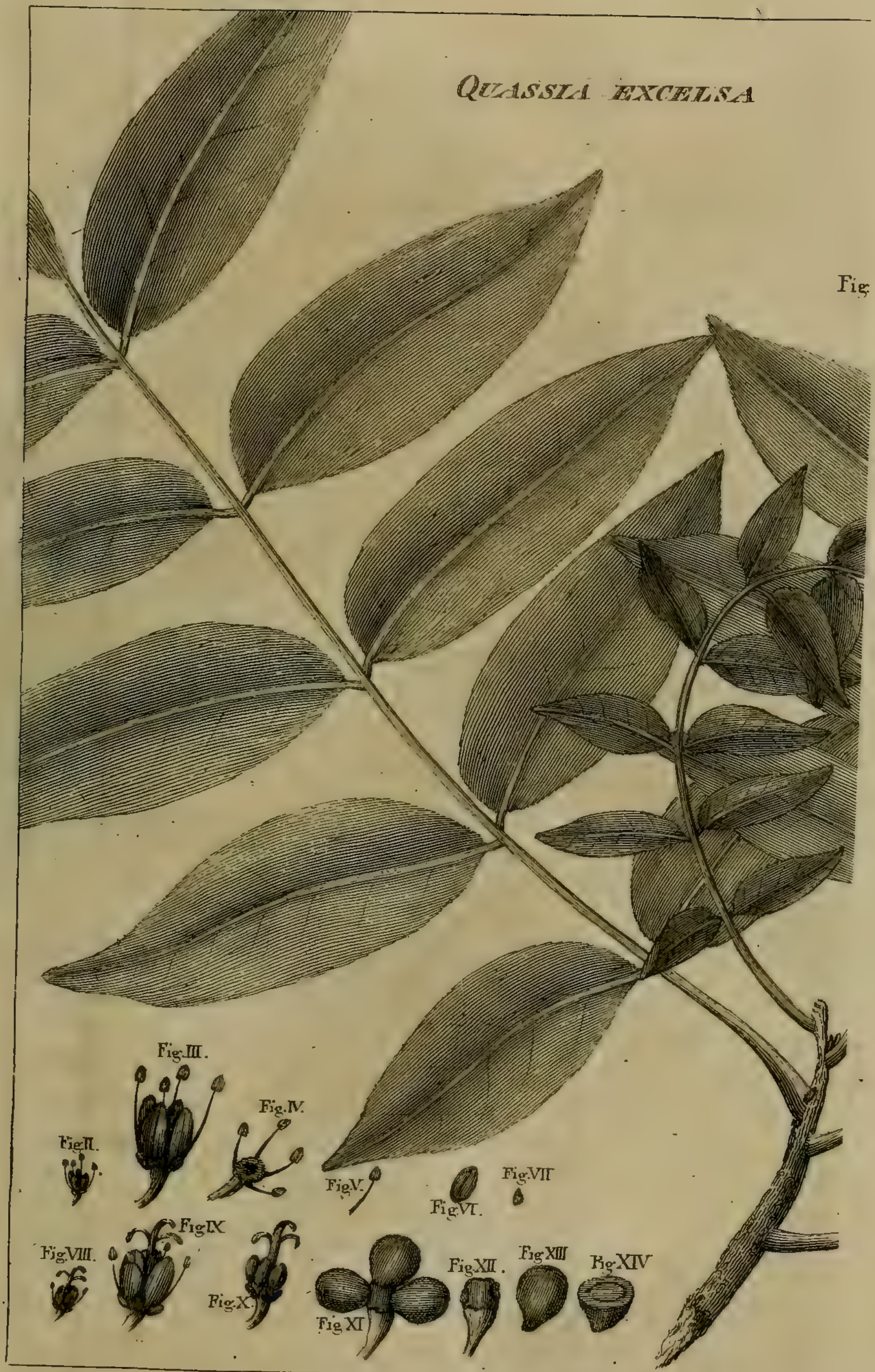
Of the Red Peruvian Bark.

The red bark, when genuine, and given brifkly in pretty large dofes, will, in particular cafes, occafion a degree of anxiety, depreffion, giddinefs and faintnefs, that are alarming to the patient and his friends, and perhaps, if not timely attended to, might be of ferious confequence. This only happens in certain conftitutions, and in weakly habits, or thofe rendered fo by difeafe.

This effect of the red bark, fo far as I know, has not been taken notice of by any writer, and when it occurs in private tice, is either not attended to, or imputed to fome other caufe. The following extract of a letter from James Graham, Efq; a worthy and refpectable gentleman of this ifland, places this circumftance in a ftrong light.

Mr Graham had been afflicted with a fever and ague for feveral months, and having confulted an eminent Phyfician here, had the red bark prefcribed him, which he was to take in dozes of thirty grains each. " On taking the firft," fays he," I inftantly perceived an unufual pungency on my tongue. After the fifth, I felt an anxiety about my breaft with faintifhnefs ; and had hardly done fwallowing the fixth, when I was feized with giddinefs, an univerfal tremor, and a profufe cold fweat. A little wine, which was given me in this fituation, relieved me confiderably. In about an hour, all the alarming fymptoms difappeared, but I remained weak and languid. From that day, however, the fever left me, and did not return till feveral months after, when it was brought on by a cold, and was removed by the bark adminiftered in the fame manner, and attended nearly by the fame fymptoms as before."

IX.



QUASSIA EXCELSA
Fig.
Fig.II.
Fig.III.
Fig.IV.
Fig.V.
Fig.VI.
Fig.VII
Fig.VIII.
Fig.IX
Fig.X.
Fig.XI
Fig.XII.
Fig.XIII
Fig.XIV

Plate VI

QUASSIA EXCELSA
Fig I
Fig II
Fig III
Fig IV
Fig V
Fig VI
Fig VII
Fig VIII
Fig IX
Fig X
Fig XI
Fig XII
Fig XIII
Fig XIV


The Flowers in there Growing state
as near as can be Remembered by
Dr Wright

CINCHONA BRACHYCARPA

The Flowers in there Growing state as near as can be Remembered by Dr Wright

IX. DESCRIPTION *of a* HUMAN MALE MONSTER, *illustrated by Tables, with Remarks. By* ALEXANDER MONRO, M. D. F. R. S. EDIN. *Fellow of the Royal College of Physicians, Professor of Medicine, Anatomy and Surgery in the University of Edinburgh, Fellow of the Royal Academy of Surgery in Paris*, &c. &c.

[*Read Nov.* 6. 1792.]

THIS monster, of which the mother was delivered by Mr THOMAS ANDERSON, surgeon in Leith, after the birth of a complete child at the full time, had its proper membranes and a placenta, with a short umbilical cord.

THE following parts were wanting in it; to wit, the bones of the head; the brain, with the organs of sight, hearing, smell and taste; the neck; about one half of the ribs; the larynx, trachea and lungs; the heart; the pharynx, œsophagus and stomach, with all the small intestines, except the end of the ilium; the anus; the liver, spleen, pancreas and omenta; the renal glands; terminations of the ureters; the middle part of the urethra; the right testicle; both arms; both patellæ; with several of the bones of the feet and toes.

A ROUND opening (see fig. 1. and 2.) which led to a thimble-like cavity, shut at its bottom, had some distant resemblance to the mouth.

THE

The ſoft parts of the trunk were ſupported by ſixteen vertebræ, ſix ribs, an os ſacrum, and two oſſa innominata. The legs had each an os femoris, tibia and fibula, with an imperfect number of the bones of the feet. See fig. 2. X. and fig. 4. 1. &c. to 16. 17.

The umbilical cord was connected at nearly the uſual height above the oſſa pubis. See fig. 1. E.

The penis, covered with a large preputium, had the uſual ſituation and ſtructure. See fig. 1. F.

The lower part of the trunk contained an inteſtinal tube, ſhut at its beginning, and compoſed of an upper part, four inches long, reſembling the end of the ilium; for it terminated in the ſide of an inteſtine, reſembling the caput coli, with its appendix vermiformis. From this place, to its lower end, the great inteſtine meaſured thirteen inches; and the end of the rectum, which was much contracted, terminated in the back part of the bladder of urine, above its ſphincter. The rectum contained viſcid ſemipellucid mucus, but no black ſtuff, like the meconium. See fig. 2. O. P. Q. R. S. T. U. V. and fig. 3. O. P.

In the meſentery and meſocolon, there were about a dozen conglobated lymphatic glands, of the uſual ſhape, colour and conſiſtence. See fig. 2. From which it appeared, that the inteſtines were provided with lacteal veſſels; and we therefore cannot doubt, that the other parts of the body were furniſhed with lymphatic veſſels, or that there was an abſorbent, as well as circulating ſyſtem in this monſter.

At the upper part of the trunk, covered by the ribs, there were two kidneys of a large ſize, with a pelvis and ureter to each. The right ureter was dilated to the ſize of a gooſe's quill. The left one was ſmall. Both were ſhut at their under ends, and had no communication with a ſmall ſac, which, in ſituation and ſtructure, reſembled the bladder of urine, and had

had an urachus coming from it. See fig. 3. W. W. Y. and fig. 2. W. X. Y.

THERE was only one teſtis, ſituated in the uſual manner, on the left ſide. See fig. 2. Z.

THE proſtate gland ſurrounded, as uſual, the neck of the bladder. See fig. 4. X.

THE urethra, which was the common paſſage for the fœces, as well as for the ſeminal liquors, and that of the ſac reſembling the veſica urinaria, was wanting from within an inch of the veſica to within an inch of the extremity of the penis. See fig. 4. V. Y. and fig. 3. F. G.

THE ſpinal marrow was of a conical ſhape, with the top or ſmall part of the cone at its upper end, and at its lower end it formed a cauda equina. From its two ends and ſides, it ſent off eighteen pairs of nerves; which, at their origin and in their progreſs, were nearly as large as they are in a perfect fœtus, or where the brain and cerebellum are connected with the ſpinal marrow. See fig. 4. 1. *&c.* to 16. *n. n.*

THE umbilical cord was nearly proportioned to the bulk of the monſter; and, at the umbilicus, conſiſted of one vein and two arteries, within which I found red blood. The vein was more capacious than both arteries conjoined; and, as ſoon as it entered the abdomen, was divided into various branches, which were diſperſed upon all parts of the body. See fig. 3. *a*, *b*, *c*, *d*, *e*, *f*, *g*; fig. 2. *h*, *i*; fig. 4. *h*, *i*.

VESSELS, every where, accompanied the branches of the umbilical vein, correſponding with them in ſize, as well as ſituation; and, joining together, formed trunks, from which, at the ſides of the pelvis, two veſſels were continued, one of them on each ſide of the veſica urinaria and urachus, to the umbilicus, which they perforated, and then went, along the umbilical cord, towards the placenta, reſembling the umbilical arteries. See fig. 3. *h*, *i*, *k*, *l*, *m*; fig. 4. *k*, *l*; fig. 2. *h*, *i*.

 UNLUCKILY

Unluckily, before I received the monſter from Mr Anderson, he had entruſted the injection of its placenta to ſome perſon, who had managed it ſo negligently, that nothing, he told me, could be determined as to the diſtribution or communication of the veſſels of the placenta with each other, or with thoſe of the placenta of the complete child, or with thoſe of the mother.

Explanation *of the* Figures, *repreſenting the parts of a human Male Monſter, of its real ſize.*

Fig. I. repreſents the fore view of it entire.

A. B. C. A circular maſs, more than two inches thick, which ſupplies the place of head, trunk and arms.

D. A thimble-like cavity, ſomewhat reſembling the mouth.

E. The umbilical cord.

F. G. The penis and preputium.

H. I. K. L. M. N. The thighs, legs and feet.

Fig. II. In this figure, at the letters A. B. C. D. F. G. H. I. K. L. M. N. the ſame parts are repreſented as in fig. I. The cavity of the abdomen being laid open by a longitudinal inciſion, we perceive,

O. P. The ſmall inteſtine.

Q. The caput coli, and appendix vermiformis.

R. S. T. U. V. The great inteſtine.

W. X. The right and left ureters.

Y. The veſica urinaria and urachus.

Z. The

Z. The left teſticle, with its ſpermatic cord, cremaſter muſcle and vas deferens.

h, *i*. Two large veſſels, at the ſides of the pelvis, furniſhed by the umbilical vein.

E. E. The two umbilical arteries.

FIG. II.* In this figure, the conglobated, lymphatic or lacteal glands of the meſentery are repreſented.

FIG. III. In this figure, the diſtribution of the blood-veſſels, chiefly, is repreſented. At the letters A. B. C. F. G. H. I. K. L. M. N. the ſame parts are repreſented as in fig. 1. and fig. 2.

O. P. ſhew the inteſtines puſhed behind the blood-veſſels to the left ſide.

W. W. The kidneys and ureters.

X. The ribs which covered the kidney, drawn towards the right ſide.

Y. The bladder of urine.

a, *b*, *c*, *d*, *e*, *f*, *g*, The umbilical vein, divided into branches for the ſeveral parts of the body.

h, *i*, *k*, *l*, Veſſels accompanying the ſeveral branches of the umbilical vein.

m, Two veſſels reſembling the umbilical arteries.

n, *n*, The ſciatic nerves.

FIG. IV. In this figure, the ſpinal marrow, and nerves connected with it, are chiefly repreſented.

A. B. C. H. I. K. L. M. N. repreſent the ſame parts as the former figures.

V. repreſents a probe paſſed from the rectum through the neck of the bladder into the urethra.

Y. A briſtle paſſed from the bladder into the urethra.

S, The ſpinal marrow.
E. The cauda equina.
1. 2. *&c.* to 16. Nerves ſent off from the ſpinal marrow in pairs.
17. The os ſacrum.
n, *n*, The ſciatic nerves.

REMARKS *on ſuch* MONSTERS.

MONSTERS wanting the head, heart and lungs, and, in almoſt every other reſpect, agreeing with that above deſcribed, have been mentioned by authors, particularly by MERY and WINSLOW *, and the learned Dr ROEDERER † has given a full deſcription of a monſter, in which one ſmall muſcular ſac only was found, inſtead of a complete heart, communicating with the continuation of one of two veins which were found in the umbilical cord; but the real courſe of the blood, or the cauſes of its motion, appear to have been miſapprehended by all theſe authors.

MERY thinks the blood of the fœtus muſt have been moved by the motion of the heart of the mother, and conſiders the want of the heart in ſuch monſters, as a ſtrong confirmation of the opinion he entertained, that there is a circulation of the blood carried on between the mother and the fœtus ‡.

As

* Mem. de l'Acad. 1720 and 1740.

† Act. Got. t. iv. 1754.

‡ MERY, Mem. de l'Acad. des Scien. 1720. 1re Reflexion. "Sa vie n'a pu avoir pour principes que la reſpiration et le mouvement circulaire du ſang de ſa mere." And in the Hiſtoire, "Le defaut du cœur prouve que le ſang qui a circulé dans ce fœtus ne recevoit pas ſon impulſion que du cœur de mere." M. MERY a toujours ſoutenu la circulation reciproque entre la mere et le fœtus, et telle que le fœtus eſt toujours comme un membre de la mere.

As WINSLOW had not found any red blood in the veſſels of the fœtus, nor traced within it the branches of the umbilical vein, but thoſe only, as he ſuppoſed, of the veſſel he called aorta, and which he thought performed the office of an artery, he is led to the ſuppoſition, that, inſtead of a circulation, there was only a ſort of progreſſion of the colourleſs blood, or lymphatic humour, to the capillary extremities of the arterial ramifications, and that it tranſuded, by little and little, and very ſlowly, into the cellular texture of all the parts, and perhaps, at laſt, paſſed through the pores of the ſkin, in the form of moiſture *.

Dr ROEDERER † not only applies the term of vena cava to the large vein with which the umbilical vein is joined to the heart; but deſcribes the cava as aſcending from the abdomen to the thorax ‡. In like manner, he not only applies the name aorta

* WINSLOW, Mem. de l'Acad. des Scien. 1740.

P. 588. " La veine ombilicale, s'étant écartée du cordon de ſon entrée dans le ventre, yformoit un tronc fort court, qui montoit tout droit et s'implantoit à la baſe du bouton cutané, *s'adoſſant* là avec le tronc d'un autre vaiſſeau de pareille groſſeur, qui ſortoit de la même baſe, et qui etant d'abord courbé vers en bas, deſcendoit derriere les paquets des inteſtins, à peu près comme le tronc de la portion inferieure de l'aorte, et ſe diſtribuoit enſuite en pluſieurs branches, de la maniere que je dirai ci après."

P. 590. " On ne voyoit pas une goutte, ni aucune apparence de ſang rouge dans toute l'etendue du corps de cet enfant; ni aucun veſtige de vaiſſeaux veineux."

P. 600. " Hors la petite portion de la veine umbilicale après ſon entrée par le nombril, je n'ai trouvé, dans tout le corps de cette enfant, aucun vaiſſeaux veineux, ni le moindre veſtige ſoit de tronc, ſoit des ramifications de veines."

P. 604. "Mais à l'egard de la circulation intrinſeque dans les parties mêmes de ce demi-corps, l'abſence ou la privation totale des vaiſſeaux veineux m'a fait conjecturer, qu'au lieu de circulation proprement dite, il n'y a eu qu'une eſpece de progreſſion ou truſion juſqu'aux extremités capillaires de toutes les ramifications arterielles, et que là ce ſang lymphatique tranſudoit, peu à peu, et très lentement dans le tiſſu cellulaire de toutes les parties. —— Et, peutêtre, paſſoit par les pores externes de la peau, en maniere de moiteur. Je n'avance tout ceci que comme des pures conjectures," &c. &c.

† Com. Soc. R. Sc. Gotting. tom. iv. com. 4.

‡ P. 109. " Duplicem autem umbilicalis funis venam largitur; altera minor, cum vena cava, ex abdomine aſcendente confluit."

aorta to the veſſel which accompanies the continuation of the umbilical veins; but ſpeaks of his aorta as aſcending from the thorax to the head *, and ſending off the ſubclavian and the carotid arteries; and remarks, that canals proper to the latter were wanting †. And he obſerves, that the aorta, after deſcending, as uſual, between the crura of the diaphragm, gave off the meſenteric, renal, lumbar and iliac arteries; and that the left iliac artery ſent off an umbilical artery; and concludes his deſcription in the following words: "Ita, quidem, ſi arte-" riæ umbilicalis dextræ, arteriæque cæliacæ defectus——ex-" cipiatur, vix ab uſitata fabrica aberrans arteria aorta in abdo-" mine diſtribuitur."

AFTER an elaborate deſcription of the ſeveral parts of the monſter, Dr ROEDERER propoſes the cauſe of the motion of its humours, in the following words:

P. 189. "MOTUS qui—humores agitat, cauſa indagatur. " Aſt aliquis, lentus licet, fœtus paraſitici humores motus " agitavit. A corde, ſueto motore, repeti iſte motus nequit, ne-" que multum auxilii propulſus in uterum maternum ſanguis " ferre poteſt. Præter vero iſtum, levem, debilemque.—— " Ipſa vaſorum actio, ſive contrahendo agat, ſive attrahendo, " vi

* P. 121. "Arteria magna, quam aortam vocant, ex abdomine in thoracem aſcendit. In thorace eandem pene directionem ſervans, nulloque cum corde canali confluens, ſola et a corde diſtincta, iter ſuum abſolvit. Nullus proinde ex aorta arcus formari poteſt, ſed laterales rami ex recto aortæ trunco emittuntur. Sunt iſti rami qui deſcripti ſequuntur.

IN regione coſtæ primæ leviſſime deſcendentes arteriæ ſubclaviæ naſcuntur; ex quibus viciſſim triplex alia ramorum ſpecies oritur, quarum primus ad cervicem, &c. Porro truncus aortæ per ſemipollicem poſtquam progreſſus eſt in duos ramos dividitur, duas nempe arterias carotides, quæ ad altitudinem laryngis ſine inſigniori ramo aſcendunt. ——Aſcendit, autem, carotis dextra, &c.——Ad latus tandem laryngis canalis communis in ſex omnino ramos dividitur."

† P. 143. "Canalis pro arteria carotide deeſt. Carotis per amplum foramen lacerum ad cerebrum tendit."

" vi illa capillaribus tubis familiari, præcipuum humoribus
" motum impertiri debet.——Accedant forſan et aliæ in fœtu
" noſtro cauſæ incognitæ, ipſa fortaſſe a colore excitata fluido-
" rum agitatio, aliaque."

But as to the direction in which he ſuppoſed the humour to be moved, he ſays nothing, and therefore leaves us to judge of his opinion, from the foregoing deſcription of the blood-veſſels.

To the opinions of all theſe authors, when fully conſidered, we ſhall find inſuperable objections.

Thus, without ſaying in objection to that of Mery, that it is ſo far from being certain, that there is a circulation of red blood between the mother and fœtus, that the contrary opinion is the moſt probable, we cannot conceive, although the anaſtomoſes of the uterine with the placentary veſſels were proved, that the mere impulſe of the blood in the minute arteries ſhould have carried the blood, not only into the trunks, but through all the capillary branches of the veſſels of the fœtus, and again back from theſe to the placenta, and from its umbilical arteries into the umbilical veins and veins of the uterus.

The opinion of Winslow is far more unſatisfactory than than of Mery. In the firſt place, it cannot be applied to the monſter deſcribed by Mery, or to that before us, where there were two ſets of veſſels. In the next place, Winslow was ſo far from tracing diſtinctly the joining of the umbilical vein with the veſſel he calls aorta, that he deſcribes it as merely *s'adoſſant* with the trunk of the aorta *.

3. Although he repeatedly affirms, that there were no venous veſſels in any part of the body of the monſter, yet his deſcription of the veſſels of the kidney will not, when conſidered, be found to correſpond with his general aſſertion; for he deſcribes a veſſel which indeed he calls arterious, but which began

* See p. 588. of Mem. de l'Acad. or Note, p. 221.

began on the fore-part of the belly above the navel, at the place where the fmall portion of the umbilical vein terminated in the cavity of the cutaneous button, from which various branches were fent into the kidney at its convex part, and from its concave part, different arteries, he fays, came out in an extraordinary manner *.

Upon the whole, as the umbilical cord is not faid to have been uncommon in fize or ftructure; as there were two forts of veffels connected with the kidney; as it is fo improbable, as to be incredible, that the fœtus received arteries without correfponding veins, or that there was merely a protrufion of the humours, and exudation of them, without circulation, I have no doubt that Winslow, efpecially as he did not inject the veffels of the umbilical cord, had miftaken the continuation of the umbilical veins, and the branches of the veffels he calls aorta, for branches of the fame veffel; and as the monfter he examined agreed very nearly, in all other refpects, with that I have defcribed, I apprehend it muft have agreed likewife in having two kinds of blood-veffels or arterious and venous canals.

The learned Dr Roederer rejects the opinion of Mery, that the blood of the fœtus is circulated by the heart of the mother, and fuppofes, that capillary attraction, heat, and fome activity of the veffels, may contribute to its motion. But as he applies the term aorta, not to the continuation of the umbilical vein, but to the other principal veffel of the monfter, and defcribes

* P. 602. "Ce tronc arteriel qui étoit comme la portion inferieure de l'aorte defcendante, au lieu de tenir la route naturelle en arriere le long des vertebres, il en étoit ici très eloigné. Il commencoit fur le devant du ventre au deffus du nombril, à l'endroit où fe terminoit la petite portion de la veine ombilicale.——Il jettoit des branches dans la maffe du rein par . . . . fa convexité. Il fortoit de la concavité plufieurs artères.

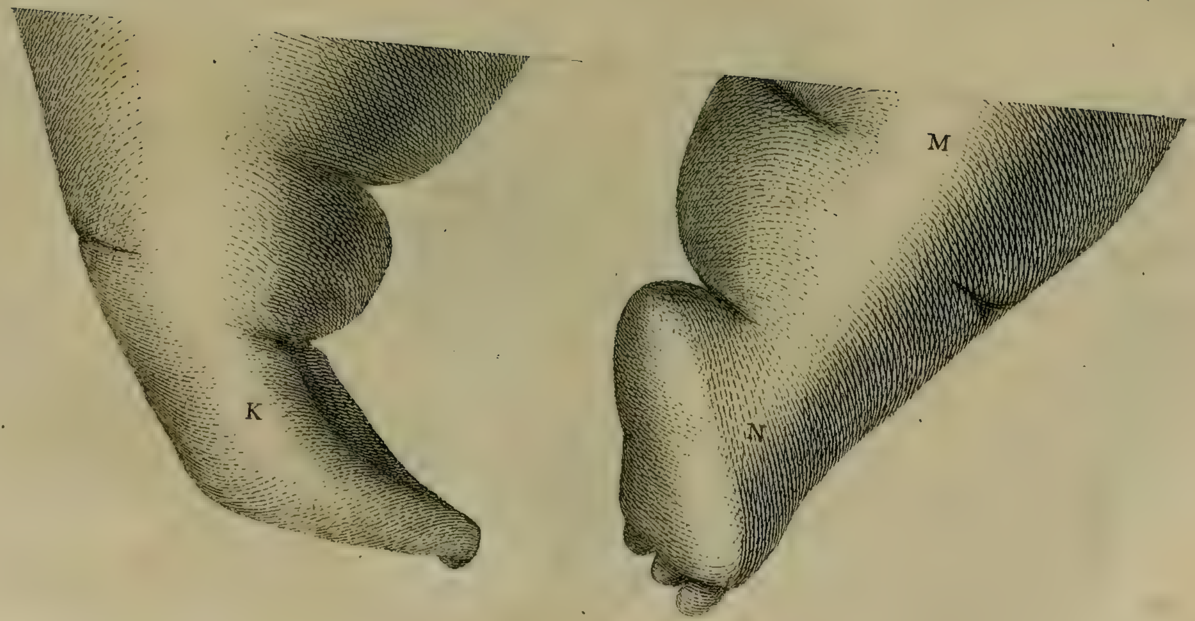


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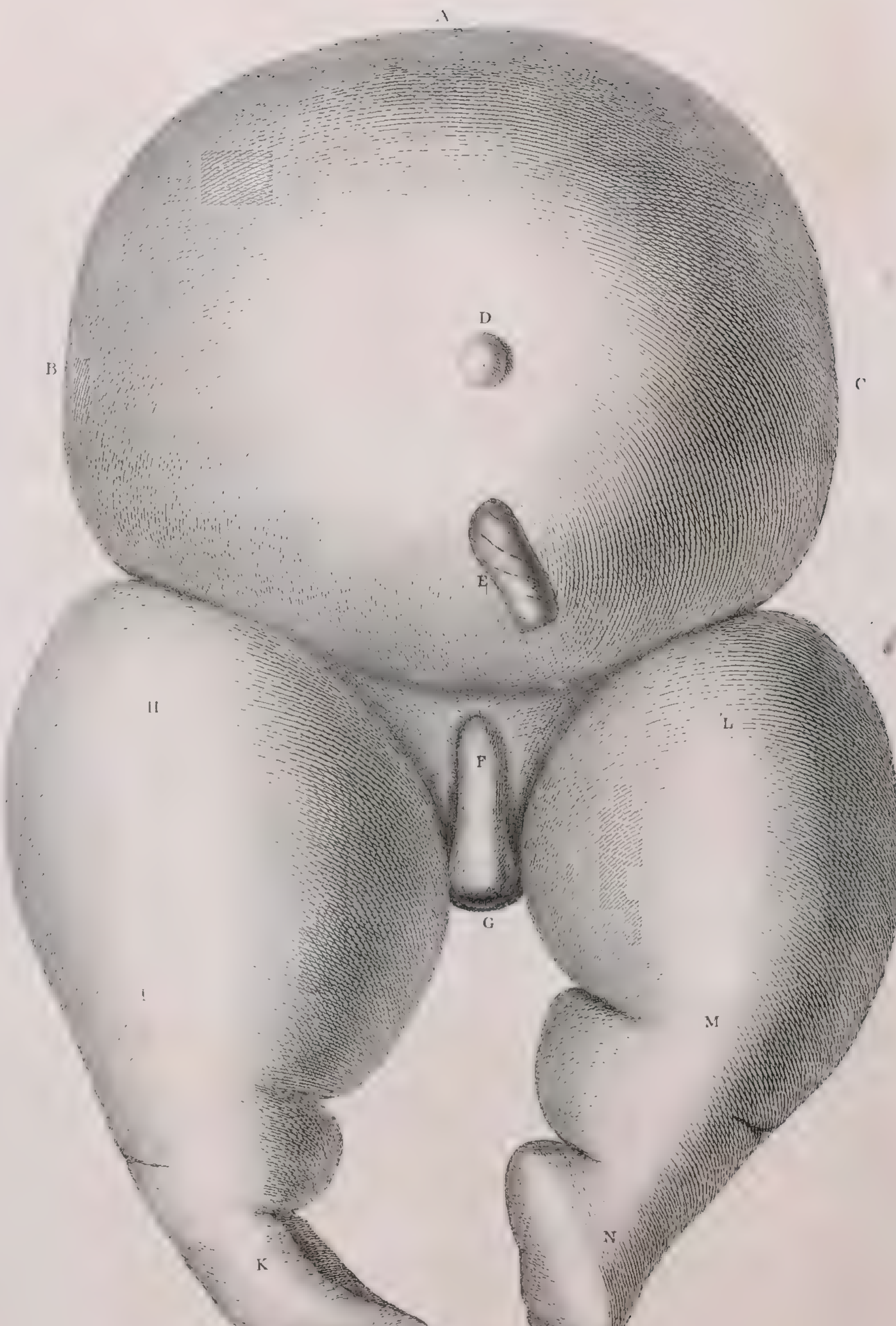
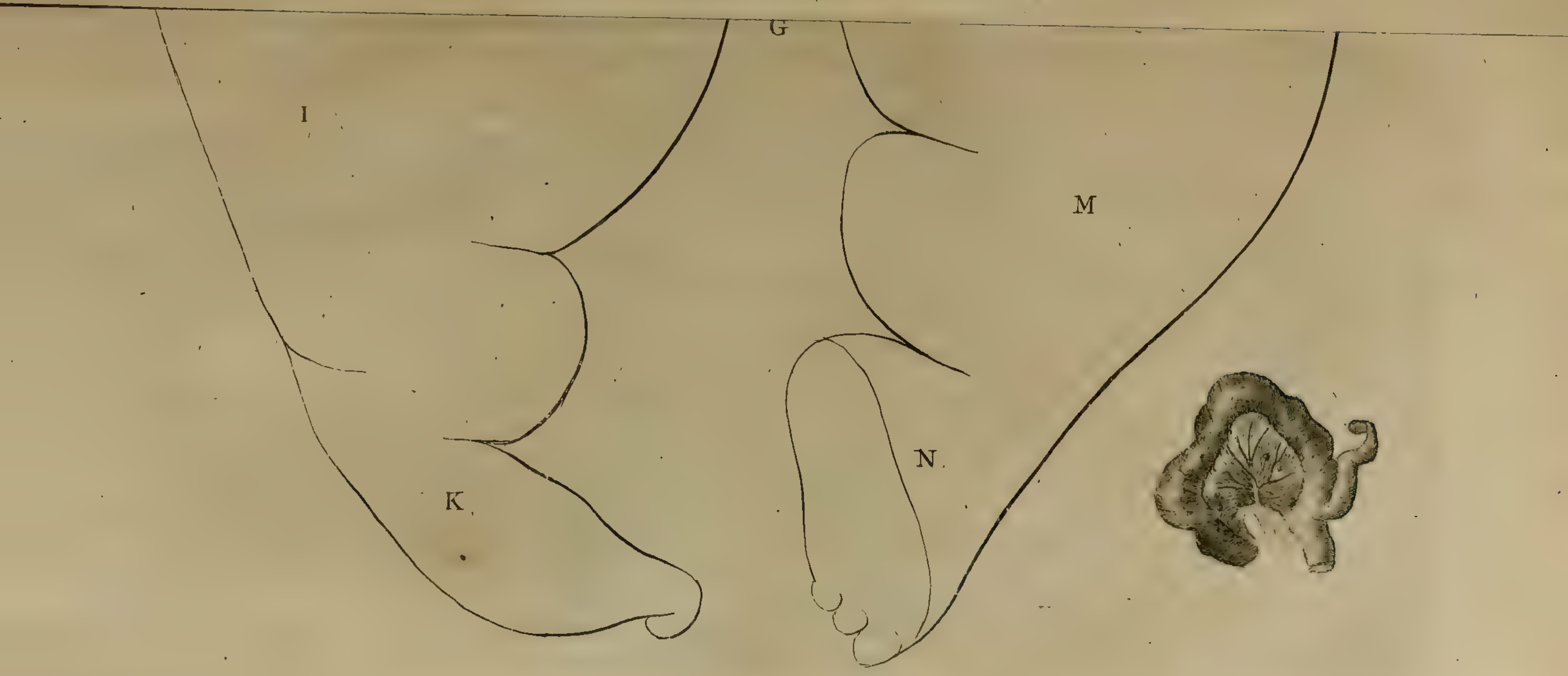
Fig. 1





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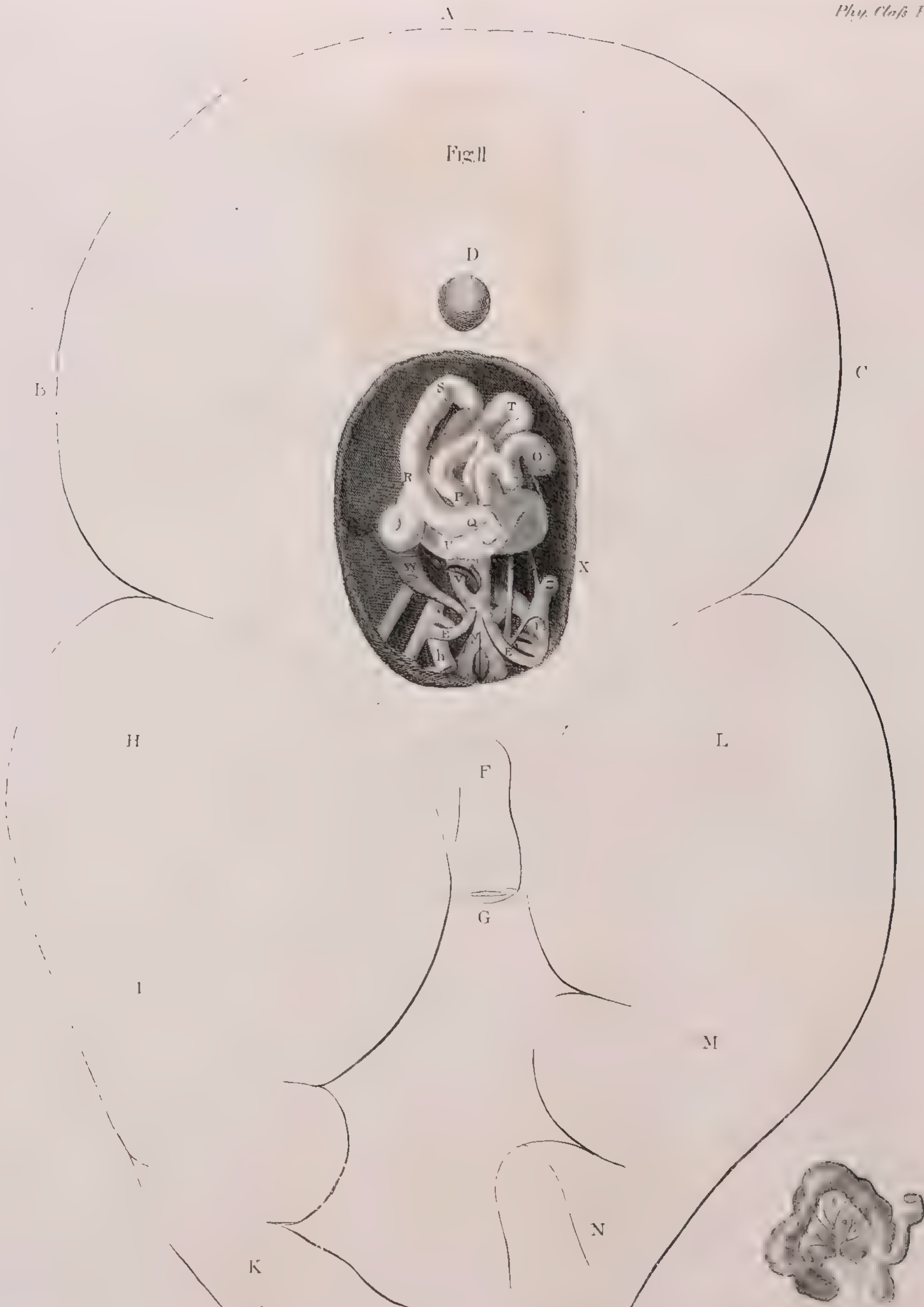
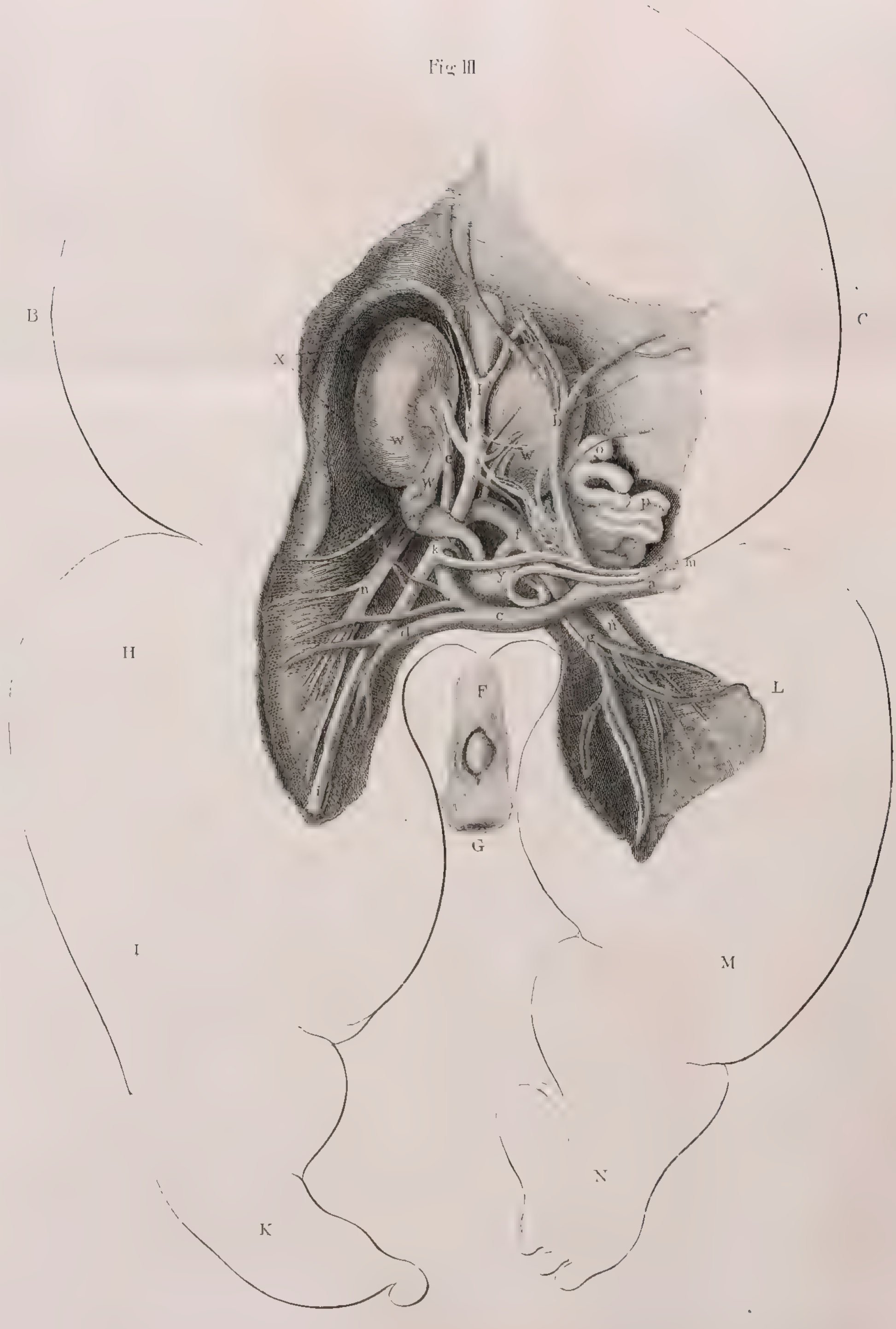


Fig. II

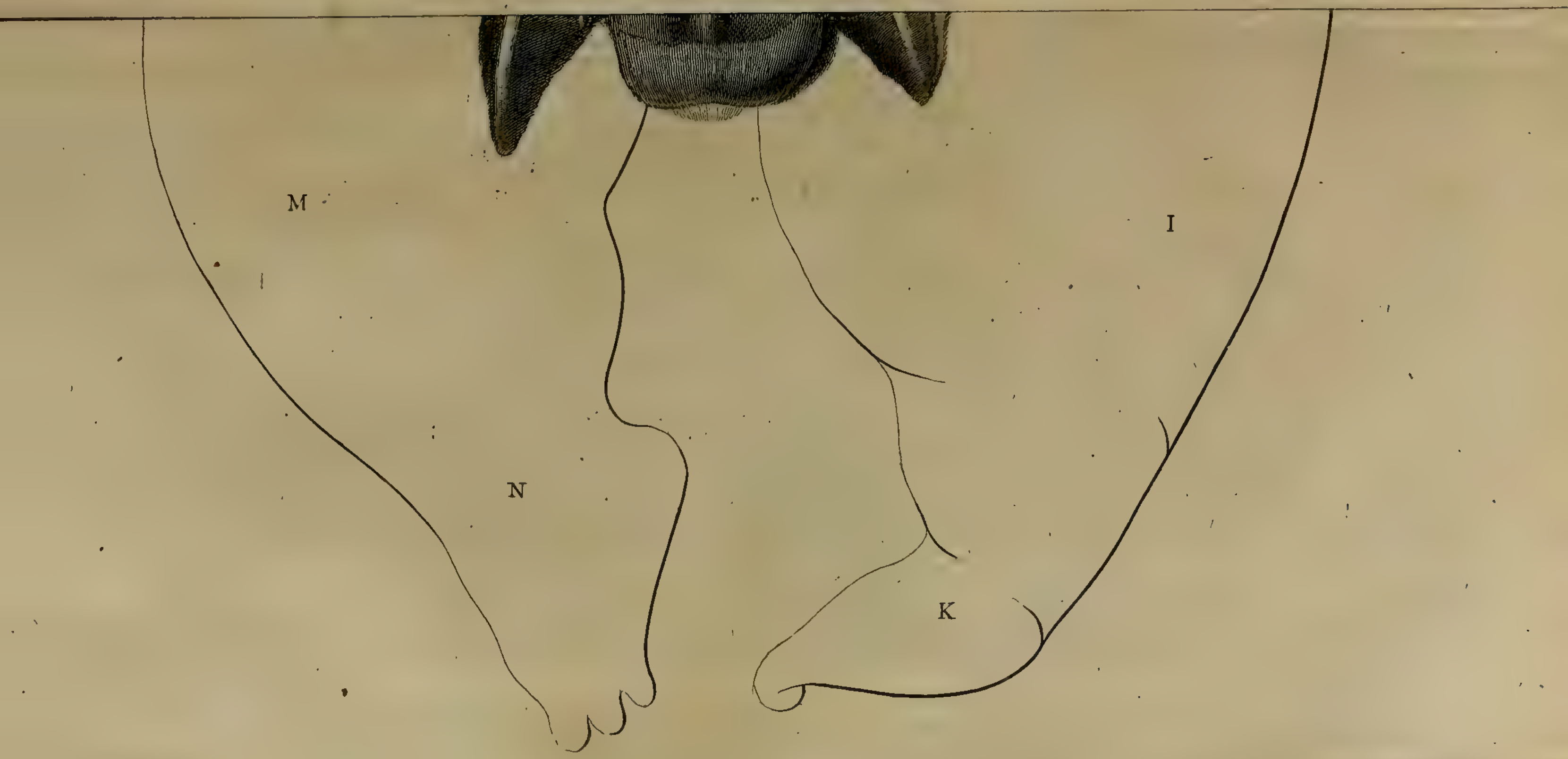
J. Fisi del.

J. Basire sc

Fig III



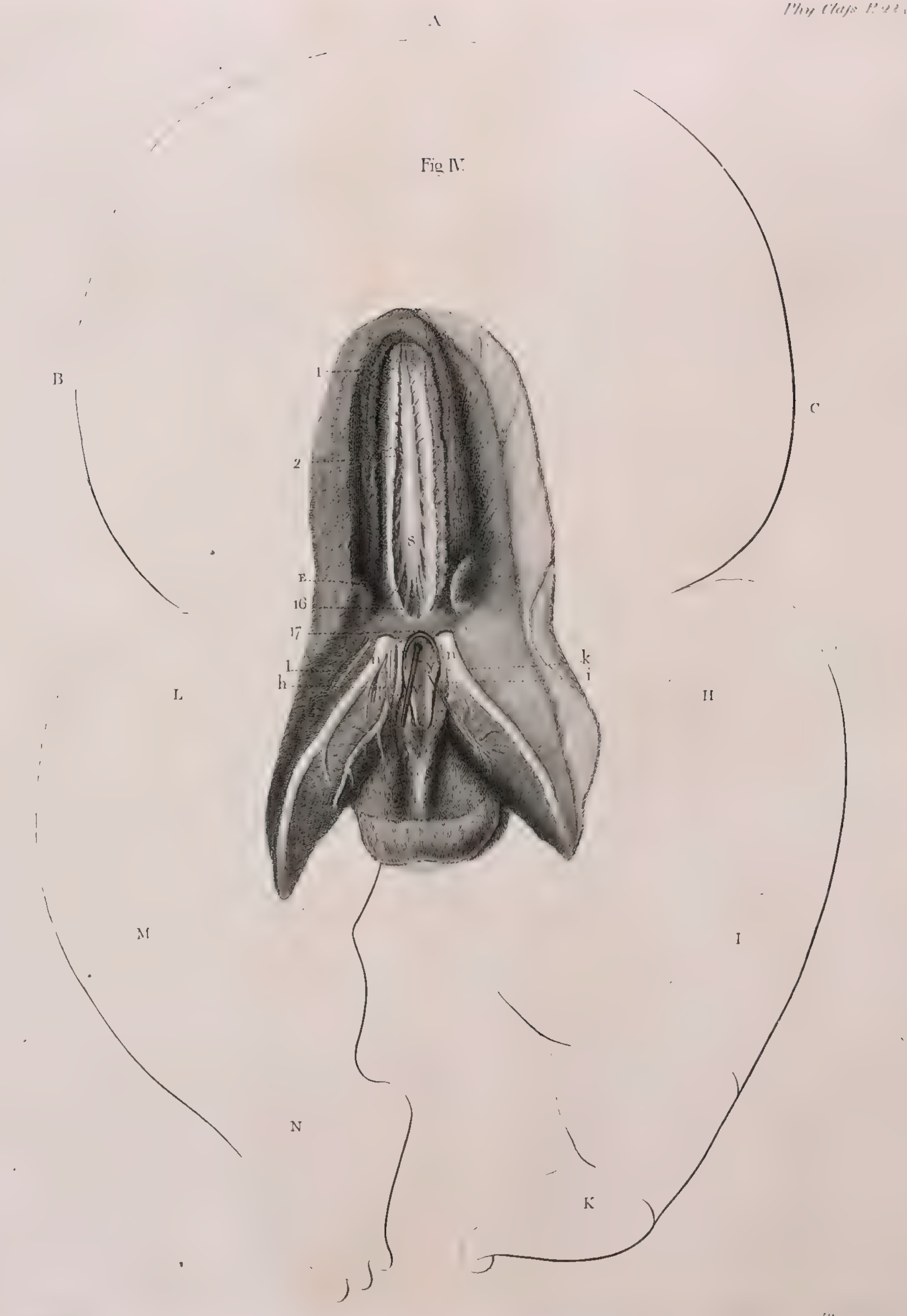
J Basire sc



A. Fyrie del.

J. Berge sc.

Fig IV.



J Basire sc.

deſcribes it as ſending branches downwards from the abdomen to the inferior extremities, and upwards from the thorax to the head, and applies the name of carotid arteries to two of theſe branches, with the additional remark, that the canales carotici were wanting, it will, I apprehend, appear evident from theſe circumſtances, and from what I am about to obſerve in the next ſection, that he miſunderſtood the direction in which the blood was moved and circulated.

Of the Direction of the Blood in this Monſter.

As there are two kinds of veſſels in the umbilical cord, and likewiſe within the body of this monſter, which we ſhall call, in the common ſtyle, arterious and venous, we cannot doubt, that theſe communicated with each other, and that the blood was conveyed by them in a circle.

To deſcribe the circle more exactly, we cannot doubt, that the blood was conveyed from the placenta by the umbilical vein into the body of the monſter. We next found, that the umbilical vein within the monſter was divided into various branches, which could be traced to all its parts, or that theſe branches performed the office of arteries, or reſembled the vena porta hepatica. Contiguous to theſe branches, we found, every where, other veſſels which formed a trunk or large veſſel, which, by its ſituation, reſembled our aorta. But we muſt ſuppoſe, that theſe branches ſerved the purpoſe of receiving the blood from the extremities of the branches of the umbilical vein, or were in reality venous veſſels. From the veſſel reſembling the aorta in ſituation, but very different in office, two veſſels were ſent off, which ran at the ſides of the bladder to the umbilicus, and formed the arteries of the umbilical cord and of the placenta, and, in the placenta, muſt have terminated

in the minute beginnings of the umbilical vein, to complete the circle in which the fœtal blood was moved.

Thus, we obſerve the umbilical vein in the placenta and umbilical cord performing the office of a vein, but its continuation within the body of the monſter, performing the office of an artery. On the other hand, we find the veſſel we have called aorta, performing the office of a vein within the monſter, and that of an artery in the umbilical cord and placenta.

Of the Cauſes of the Motion of the Blood in this Monſter.

In the monſter examined by Winslow, which I have endeavoured to ſhew agreed very nearly with that I have deſcribed, no red blood was found in any of the veſſels; and therefore we muſt conclude, that none of the red arteries of the mother anaſtomoſed with the umbilical veins; and even where there is the ordinary ſtructure, it is ſo far from being certain, that the veſſels of the uterus, which convey red blood, anaſtomoſe with thoſe of the umbilical cord, that the contrary is the moſt probable opinion.

It is therefore very improbable, that the blood in the umbilical vein was puſhed on by the heart of the mother.

Further, though we were to admit, that the arteries of the mother anaſtomoſed with the umbilical veins, yet, as their communications muſt be ſuppoſed very minute, and the momentum of the blood in them very much broken, we cannot conceive, that it could have been ſufficient to puſh the blood through the terminations of all the branches of the umbilical veins, in the ſeveral organs of its body, into the veſſel we call aorta, and again from the aorta back to the placenta by the umbilical arteries, and through the minute branches of theſe to the veins of the mother, and beginnings of the umbilical veins.

We

We therefore muft conclude, that the circulation of the blood in the placenta and body of the monfter, was carried on by a well regulated mufcular action of the blood-veffels. In one of the worms, the echinus efculentus, I found in the mefentery, which is a principal part of it, two fuch large veffels without a heart, and which, we can fcarcely doubt, refembled our aorta and cava, and circulated its fluid; and in fifhes *, the blood which paffes through the liver defcribes three circles, and in all other parts of the fifh the blood defcribes two circles before it returns to the heart; which motion of it we muft fuppofe to be chiefly owing to the mufcular action of the veffels, as the force of the heart appears to be as much fpent in the gills of the fifh as in the lungs of a man.

From confidering the manner and caufe of the motion of the blood in this monfter, and comparing with it the motion of the blood in fifhes and in the fea egg, we are, by analogy, led to the following general conclufions:

1. The arteries contribute much to the circulation of the blood in our bodies.

2. It is probable that, in man, the veins likewife affift in circulation; and, in particular, there can be no doubt, that the vena portarum, by its action, contributes much to the motion of the blood through our liver.

3. For the like reafons, we may conclude, that arterious veffels, independent of the impulfe of the heart, may act in fuch a manner, as to perform the fecretion of liquors, to nourifh the folids, and to add to their bulk; and particularly, that the branches of the vena portarum change certain parts of the blood into bile.

* See Monro on Fifhes, p. 67. Tab. xliii.

Remarks on the Nervous Syſtem of this Monſter.

1. As the ſpinal marrow, and pairs of nerves ſent off from it, had nearly the uſual ſize and ſtructure, although the brain, cerebellum, and medulla oblongata, were entirely wanting, we find reaſon for calling in queſtion the common doctrine of authors, which teaches, that the ſpinal marrow and nerves derive their origin from the brain and cerebellum, and are dependent upon it as much as the ducts of glands are upon the glands which ſend liquors into them.

2. Further, as the ſeveral parts of this monſter were furniſhed with nerves, and as we have found, that its arteries and veins, by a well-regulated, varied and complicated action, circulated the blood, we muſt ſuppoſe, that their muſcular fibres were actuated by thoſe nerves. We therefore find in this monſter, not only the exiſtence and common appearance of the ſpinal marrow and nerves connected with it, although the brain and cerebellum were wanting, but we have proof that theſe, independent of the brain and cerebellum, may actuate the muſcular fibres in the veſſels of an animal, or that nervous energy, or fluid, as it is commonly called, is not derived from the brain and cerebellum ſolely; that is, we conclude, that the nerves, as well as the brain and cerebellum, are capable of furniſhing nervous energy; and that there is no more reaſon for believing, that the nerves are derived from the brain, than that the brain is derived from the nerves; or all the parts and branches of the nervous ſyſtem appear to poſſeſs the general power or office of furniſhing nervous energy.

Of

Of the Duration of the Life of this Monſter.

As in man and ſimilar animals, the direct or indirect influence of reſpiration ſeems neceſſary for the continuance of life, and as the lungs were wanting in this monſter, we muſt ſuppoſe, that it could have outlived the ſeparation from the mother for a very ſhort time only. But when we add to this, that, by the ligature of the umbilical cord, a ſtop would be mechanically put to the circulation of its blood, it is evident, that its life muſt have terminated with its delivery.

Of the Time at which this Monſter muſt have acquired the Structure which has been deſcribed.

As this monſter was provided with a diſtinct placenta and membranes, and its body ſurrounded with and protected by the liquor amnii; as no veſtige appeared of the brain, cerebellum, organs of the ſenſes, or other parts of the head; as nervous threads, proper to this monſter, aſcended from the upper end of the ſpinal marrow towards the upper parts of its body; as its ſyſtem of circulating veſſels was complete without a heart, and the manner of their branching different in many reſpects from the common ſtructure: it muſt ſurely appear, to an unprejudiced perſon, abſurd to ſuppoſe, with many eminent authors, that ſuch monſters, when firſt produced, had the ordinary ſtructure, and that this was afterwards altered by preſſure and other accidents.

The like obſervation may be extended to many other monſters in my poſſeſſion, I believe I might ſay to almoſt all other monſters

monſters which have been deſcribed ; particularly to two, of which I publiſhed a deſcription, illuſtrated with figures, in my work on the Nervous Syſtem. In one of them, a human monſter, one heart ſupplied two heads and two trunks. In the other, a kitten, one heart, conſiſting of two auricles and two ventricles, ſent off from its left ventricle one aorta, which ſupplied one head and two bodies *.

* See Obſervations on the Nervous Syſtem, Tab. viii. ** and Tab. xii.

X. EXPERIMENTS *relating to* ANIMAL ELECTRICITY. *By ALEXANDER MONRO*, M. D. F. R. S. EDIN. *Fellow of the Royal College of Physicians, Professor of Medicine, Anatomy and Surgery in the University of Edinburgh, Fellow of the Royal Academy of Surgery in Paris*, &c. &c.

[*Read Dec.* 3. 1792.]

ON the 3d of November laſt, Sir JAMES HALL and Dr RUTHERFORD aſked me to repeat with them ſome experiments on what has been called Animal Electricity, which were firſt performed by Dr GALVANI, Profeſſor of Anatomy at Bologna, and of which an account had been communicated by Mr SEGUIN of Paris to Dr BLACK, in a letter dated Paris, 3d Auguſt.

WE accordingly, with the help of my aſſiſtant Mr FYFE, repeated them in the following manner:

WE cut a living frog into two parts, a little above the lower end of the ſpinal marrow. We then put the middle part of a bit of tinfoil, about one-tenth of an inch in breadth, and two inches long, under the beginning of one of the ſciatic nerves, and then doubled the tinfoil over the nerve, that is, we included the nerve in the doubling of the tinfoil. We next placed one half-crown ſilver piece between the table and loins of the frog, and another between the table and its leg. We then bended a piece of braſs-wire, about the ſize of a common ſtocking-

ftocking-wire, and after laying one end of it upon the half-crown piece which fupported the leg, we with the other end of the wire preffed the doubled tinfoil againft the half-crown piece which fupported the loins, and found, that inftantly convulfions were produced in the mufcles of the thigh and leg.

When the tinfoil was paffed around both fciatic nerves, both legs were convulfed, although the half crown piece was placed under one of the legs only. Thefe experiments were tried more than an hour after the fpinal marrow had been cut acrofs, with the fame fuccefs.

In another frog, in which the fpinal marrow was not divided, we found the fame means produce the fame effects upon the legs, but did not obferve, that the mufcles above the tinfoil in the trunk or fore-legs were affected.

When the touches were quickly repeated, the motions feemed to become, by degrees, lefs vigorous, but did not ceafe after repeating them often, even where the fpinal marrow had been divided tranfverfely.

On the 10th of November, I profecuted the fubject farther by the following experiments:

Experiment I.

After cutting off the hind legs of a living frog, I laid bare the upper part of its fpinal marrow, and furrounded it with tinfoil; and in another frog, after laying bare the brain, I thruft into it a bit of tinfoil. I then placed one half crown piece between the table and the body of the frog, oppofite to the tinfoil, and another half crown piece between the table and the lower part of the trunk of the animal, and, on applying the wire, as before, I found convulfions produced in the fore-legs and body. Gold had nearly the fame effect as filver; but the convulfions

convulſions were much leſs obſervable, when lead, iron or copper were ſubſtituted inſtead of theſe.

EXPERIMENT II.

I NEXT tried all the above mentioned experiments with one half-crown piece only, placed oppoſite to the tinfoil; and on preſſing the tinfoil againſt the ſilver-piece, by means of a braſs-wire which I held in my hand, I found, that the muſcles were convulſed exactly in the ſame manner as where two pieces of the ſilver were employed in the manner before mentioned.

EXPERIMENT III.

I FOUND likewiſe, that the experiment ſucceeded equally well, although the ſilver-piece did not touch the body of the animal, but was merely brought into contact with the tinfoil put around the nerve, by preſſure with a braſs-wire held in the hand.

EXPERIMENT IV.

AFTER incloſing the upper part of the ſciatic nerve in tinfoil, I tied a linen-thread around it, where it is about to paſs from the trunk into the thigh, ſo tight as to deprive the muſcles of their power of acting by the ordinary exertions of the animal, and the ſkin and toes of their feeling, yet when, with a braſs-wire held in my hand, I preſſed the tinfoil againſt the ſilver-piece, the muſcles of the limb were violently convulſed.

Experiment V.

I divided tranſverſely all the parts of a frog at the pelvis, then tied together the divided parts of one of the ſciatic nerves with a linen thread. I afterwards paſſed the tinfoil around the nerve, at a conſiderable diſtance above the ligature, and found, that when, with a braſs wire, I preſſed the tinfoil againſt a half crown piece, laid on the table at a little diſtance from the frog, the muſcles of the leg were inſtantly convulſed.

Experiment VI.

When, after dividing both ſciatic nerves tranſverſely, I tied the upper part of the right ſciatic nerve, incloſed in the tinfoil, to the lower part of the left ſciatic nerve, and then, with a braſs wire, preſſed the tinfoil againſt a piece of ſilver, the muſcles of the left leg were convulſed.

Experiment VII.

The event was the ſame when the divided parts of the nerves were croſſed over each other, without being tied together.

Experiment VIII.

The event was the ſame, when the animal, with the metals, were placed on the top of a large glaſs-jar inverted, or on a plate of window-glaſs, ſupported on two pieces of ſealing-wax.

Experiment IX.

I passed the tinfoil around portions of the ſkin, the muſcles, the inteſtines, and around the femoral blood-veſſels of frogs, without obſerving convulſions produced, when the tinfoil was applied to the ſilver by means of the braſs-wire.

Experiment X.

I laid bare the ſciatic nerve in the back part of the thigh of a young rabbit, and incloſed it in tinfoil, and then applied the tinfoil, by means of a braſs-wire, repeatedly to a half-crown piece, laid on the table, and obſerved convulſions of the leg produced on each application. I after that cut tranſverſely the lower part of the ſpinal marrow, and then, with a braſs-wire held in my hand, I preſſed the tinfoil again to the ſilver, and kept it applied for a few ſeconds, which occaſioned convulſions ſo quickly repeated, that the leg became rigid. Immediately thereafter, the muſcles were relaxed, and their contractile power ſeemed to be exhauſted, as repeated applications of the tinfoil to the ſilver produced no farther motion of the limb.

Remarks and Queries.

From the accounts we have received of the experiments of Dr Galvani and Dr Valli, it appears, that both theſe celebrated authors have ſuppoſed, " That the circulation of the " nervous fluid from the nerves to the muſcles, is nearly ſimilar " to the circulation of artificial electricity in the Leyden phial ;

 " and

" and as the circulation of the Leyden phial ſuppoſes two con-
" trary electricities, the one more condenſed or poſitive, and
" the other leſs ſo or negative, ſo Profeſſor GALVANI concludes,
" that a ſimilar diſtinction takes place in the bodies of animals,
" and that one of theſe electricities, to wit, the condenſed or
" poſitive, is ſeated in the nerves, and the other in the muſcles *."

HENCE both of them have conceived it neceſſary, to eſtabliſh a communication between the nerve and the muſcle, by means of metalline coating of the nerve and pieces of metal and metalline conductors; or by coating the nerve with lead or tin, then laying one piece of ſilver in contact with the tin, and another in contact with the muſcle; and, in the laſt place, eſtabliſhing a communication between the two pieces of metal, or between the nerve and the muſcle, by means of a braſs-wire, which they term a conductor †.

BUT, inſtead of this complex apparatus, I have found, from the above experiments, that the muſcle is thrown into action, although no metal is directly in contact with it, or when the communication between the metals and the muſcle is made by the nerve alone.

IT appears therefore, that Profeſſor GALVANI and Dr VALLI have allowed preconceived theory to conduct their experiments, inſtead of allowing their experiments to conduct their theory; in conſequence of which, ſeveral of their experiments have been performed with leſs accuracy than might have been expected. Thus, they tell us, that if the conductor is firſt applied to the muſcle, the convulſions are ſtronger than when it is firſt applied to the nerve; that the ſhocks are ſtronger when the feet communicated with the earth, *&c.* whereas the application of the conductor to the muſcles, or of the feet to the earth, are quite out of the queſtion.

2. WE

* See Medical Facts and Obſervations, Lond. 1792. p. 187, 188.

† Ditto, p. 187. 191. 211.

2. We have found, that when a piece of ſilver is brought in contact with the tinfoil coating of a nerve, the muſcles in which that nerve terminates, are thrown into action, although the nerve has been ſurrounded with a tight ligature between the coating and the muſcle, or even although it has been divided by a tranſverſe inciſion, provided the divided parts are again brought into contact, or tied together by a thread.

3. When we tie the coated nerve, after it is cut tranſverſely, to another nerve which has been cut tranſverſely, we have found, that the muſcles ſupplied by the latter are thrown into action.

4. After the ſpinal marrow and whole body of the frog were divided tranſverſely about the middle of the back, and the tin coating and ſilver were applied to the ſciatic nerve, I did not obſerve, that the muſcles at the loins and pelvis were thrown into action, or the effect produced by the metals did not influence muſcles ſupplied by branches of nerves ſent off from the ſpinal marrow or ſciatic nerves above the coating.

It appears, that the nerve of a living animal, whether entire, or cut and rejoined, conducts that matter by which the muſcle is influenced more readily than the ſkin, the fleſh or the blood-veſſels do.

5. Although, on repeating Dr Galvani's experiments, it ſhould be proved that electrical matter, drawn from a cloud or excited by the common machinery, and conducted to a nerve, and that matter, which is put in motion by the application of certain metals to each other and to a nerve, produce ſimilar motions in the muſcles in which the nerve terminates, we are not at liberty to take for granted, as Galvani and Valli ſeem to have done, that the electrical matter and this matter are the ſame, as the nerves may be affected by ſtimuli of different kinds.

6. As

6. As an animal does not feel nor act by the medium of a nerve which has been divided tranfverfely, although its divided parts are placed contiguous, or tied together; as the mufcles fupplied by nerves above the place coated are not thrown into action; the above experiments, or thofe of GALVANI and VALLI, inftead of proving, as they have fuppofed, that the matter which is excited is electrical, and the fluid of the nerves the fame with it, appear to fhow, that the electrical fluid, or matter put in motion by the different metals, is quite different in its nature from the nervous fluid, as the courfe of the nervous fluid, but not that of the electrical, can be intercepted by ligature or incifion of the nerve.

7. As the action of the mufcles, in the above experiments, is not produced, nor even increafed, by connecting the coating of the nerve with the mufcle by means of a wire, there is no foundation for the opinion of GALVANI and VALLI, that the nerve is electrified plus, and the mufcle minus, or that the electricity of the one is pofitive, and that of the other negative.

8. WE feem therefore to be led to the conclufion, that the matter or fluid which is excited or put in motion by the application of the different metals to each other, and to the nerve, ferves merely as a powerful ftimulus to that energy or fluid which is lodged in the nerves.

To fupport this way of reafoning, we may obferve, that in a warm blooded animal, the rabbit, although convulfions were repeated for a confiderable length of time when the nerve was entire, yet, after dividing the nerve and intercepting the further fupply of nervous energy from the brain, the action of the mufcles ceafed in a few feconds, by keeping the two metals contiguous, which is readily explained on the fuppofition, that the nervous energy or fluid, lodged in the nerve beyond the

place of the incifion, was exhaufted; and Dr VALLI himfelf, by obferving, that, after the electricity, as he calls it, of a limb is exhaufted, if the coating of a nerve be moved higher up, the action of the mufcles may be renewed *, furnifhes a fact which, I apprehend, may be explained on the fame principle.

XI.

* Medical Facts and Obfervations, Art. xx. p. 218.

XI. *An* Account *of repeated Shocks of* Earthquakes *felt at* Comrie *in* Perthshire, *in a Letter to the Reverend Mr* Finlayson, F. R. S. Edin. *from Mr* Ralph Taylor. *Communicated by Mr* Finlayson.

[*Read April* 5. 1790, *and Feb.* 4. 1793.]

Dear Sir, *Ochtertyre, Jan.* 19. 1790.

THE earthquakes which have lately taken place at Comrie * and its neighbourhood, are certainly very deſerving of attention. I ſhall therefore cheerfully comply with your requeſt, and give you as particular a deſcription as I can of ſuch of them as have been moſt remarkable. To give a particular account of all the *noiſes* or *concuſſions* which, during the laſt half-year, have been heard or felt at Comrie, and within a ſhort diſtance to the north, eaſt and weſt of that village, is beyond my power, and would indeed be of little uſe. With regard to theſe ſmall concuſſions, it will be ſufficient to ſay, that many of them have ſometimes been obſerved to ſucceed one another in the ſpace of a few hours; that they take place in all kinds of weather; that they are thought by ſome people to proceed from

* Comrie is a village about twenty-two miles weſt of Perth, ſituated in the valley of Strath-Earn, and on the north ſide of the river Earn, about four miles below the place where it iſſues from the lake. The remains of a Roman camp on the oppoſite ſide of the river, have made the name of this village very well known to Scottiſh antiquaries.

from N. W. to S. E. and by others from N. E. to S. W.; that they have not been obſerved to affect the barometer; that they do not extend in any direction above three or four miles from Comrie; and that towards the ſouth they are bounded by the Earn, which is in the immediate vicinity of the village. The ſame perſon, though beſtowing the minuteſt attention, is often uncertain whether they proceed from the earth or from the air, ſometimes believing them to come from the one, and ſometimes from the other; neither do all agree with reſpect to the ſeat of any one of them.

After the ſtricteſt enquiry, I find it impoſſible to determine with accuracy the date of any of the concuſſions which took place before the 2d of September laſt. Some people in the neighbourhood of Killin aſſert poſitively, that they heard unuſual rumbling noiſes in the month of May; but the impreſſion which theſe noiſes made was ſo faint, that they would probably have been ſoon forgotten altogether, had they not been ſucceeded by concuſſions of a leſs equivocal nature. Towards the end of Auguſt, two or three ſhocks are ſaid to have been felt at Dundurn, Dunira Lodge and Comrie; but I have not been able to learn the preciſe day, or hour on which any of them happened. The truth is, the concuſſions hitherto obſerved were feeble, and the minds of the people ſeem not to have been rouſed to particular attention till the 2d of September. About eleven o'clock that evening, a ſmart ſhock was felt at Comrie. I myſelf heard here *, for the firſt time, a rumbling noiſe, which I took for that of a large table, dragged along the floor above ſtairs, and which I probably would never have thought of again, unleſs my attention had been turned to it by the alarm which it had excited in the neighbourhood. Many other feeble noiſes or concuſſions are ſaid to have been obſerved in Glen-Leadnach and about Comrie during the months of September and October. At that time, however, I confeſs I was diſpoſed to doubt the numerous reports of earthquakes with which the

country

* Ochtertyre is about four miles E. N. E. from Comrie.

country was filled, and to aſcribe them to the workings of an imagination, on which the alarm of the 2d of September ſtill continued to be impreſſed.

On the 5th of November, a concuſſion took place two or three minutes before ſix o'clock P. M. which was too violent to be miſtaken. Some compared the noiſe which accompanied it to that of heavy loaded waggons, dragged with great velocity along a hard road or pavement, and thought, that it paſſed under their feet. To me it ſeemed as if an enormous weight had fallen from the roof of the houſe, and rolled with impetuoſity along the floor of the rooms above; and it muſt have made a ſimilar impreſſion on the ſervants, for ſome of them inſtantly ran up ſtairs to diſcover what had happened. Others were ſenſible of a tremulous motion in the earth, perceived the flames of the candles to vibrate, and obſerved the mirrors and kitchen-utenſils placed along the walls to ſhake and clatter. There is alſo reaſon to believe, that the waters in the Loch of Monivaird, in the near neighbourhood of Ochtertyre, ſuffered unuſual agitation, as the wild fowl then upon the loch were heard to ſcream and flutter. The noiſe on this occaſion, as far as I can judge, did not laſt above ten or twelve ſeconds. During the courſe of the day, the mercury in the barometer roſe and fell ſeveral times, and at ſix o'clock it ſtood at $28\frac{1}{2}$ inches. The ſky was then perfectly ſerene, and hardly a breath of wind was to be felt; but next morning, about ſix o'clock, a violent tempeſt roſe, which raged without intermiſſion for twenty-four hours.

At Glen-Leadnach, Comrie and Lawers, this concuſſion was much more violent, and the noiſe that accompanied it much more alarming. The inhabitants of theſe places, and of Aberuchill and Dunira, declare, that they perceived diſtinctly the earth heaving under them, and the motion communicated to their chairs, and other furniture. They imagined that the ſlates and ſtones were tumbling from their houſes, and many of them ran out in the greateſt trepidation, from the notion,

notion, that the roofs were falling in. Even the domeſtic animals were alarmed, and contributed, by their howls and ſcreams, to increaſe the terrors of the people. Though I have not been able to diſcover whether *Loch Earn* was ever agitated by theſe concuſſions, there is little doubt, that the *river* near Comrie was affected on this occaſion, as two men then on its banks heard the daſhing of its waters. This great ſhock was ſucceeded by a number of thoſe ſlighter rumbling noiſes which have been already mentioned. Not leſs than thirty of them were counted in the ſpace of two hours after it happened; but they did not extend above two miles to the eaſt, north and weſt of Comrie.

On the 10th of November, at three o'clock P. M. we had here another ſhock of much the ſame length, violence and extent, as that on the 5th. The mercury in the barometer on this day was more ſtationary than on the former, and at the time of the earthquake was 29 inches high. The weather was calm and hazy. It was a market-day at Comrie; and the people, who were aſſembled from all parts of the country, felt as if the mountains were to tumble inſtantly upon their heads. The hard-ware expoſed for ſale in the ſhops and booths ſhook and clattered, and the horſes crowded together with ſigns of unuſual terror.

About one o'clock P. M. of the 29th December, we had another pretty ſmart ſhock, during a very violent ſtorm of wind and rain, which continued the whole day, and which was at its height during the time of the earthquake. Indeed, as has been remarked already, theſe concuſſions ſeem to have no dependence on the weather. According to the accounts of thoſe who live neareſt to the centre of the phenomena, rumbling noiſes, like thoſe above deſcribed, may be heard in all ſtates of the atmoſphere.

Though I mention no more of theſe earthquakes, you are not to conclude, that many more have not taken place, and ſome of them perhaps equally violent with thoſe of the 5th and 10th

 of

of November. Several ſhocks have happened during the ſtillneſs of the night, which, even at this diſtance from Comrie, where their centre ſeems to be, have been abundantly terrifying. But the great reſemblance, or rather the perfect ſimilarity of their effects, and of the impreſſion they make on our minds, renders it unneceſſary for me to trouble you with a particular deſcription of each of them.

The direction of all the noiſes or concuſſions I have obſerved, great as well as ſmall, appeared to be in the ſame line from N. W. to S. E. Others deſcribe them as ſometimes proceeding in that direction, and ſometimes as coming from N. E. to S. W. I have not heard any other line of direction aſcribed to them.

Upon the fulleſt enquiry, I find, that theſe earthquakes have been very limited in point of extent. The greater ſhocks have been feebly felt at Loch Earn head, about Killin, and at Ardonich, on the ſouthern bank of Loch Tay. They do not appear to have extended farther eaſtward on that lake; and, what is more remarkable, they have not been felt in Glen-Almond, or the ſmall glen through which the military road from Crieff to Tay bridge paſſes. The farmer at Auchnafree, (which lies at the head of Glen-Almond, and is ſeparated from Glen Leadnach only by the mountain Benechoni, over the northern ſide of which his ſhepherds daily travel), has aſſured me, that neither he, nor any of his people, have been at any time ſenſible of the leaſt extraordinary noiſe or concuſſion. Towards the eaſt, the two firſt great ſhocks extended to Monzie, Cultoquhey and Dollary, about ſeven miles diſtant from Comrie. The ſhock of the 5th of November reached ſtill farther, and was felt, though but faintly, at Ardoch and Drummond Caſtle towards the S. E. In the direction of the ſouth, however, the banks of the Earn ſeem to be its general boundary, as the noiſe of the moſt violent concuſſions was heard but faintly at the *manſe* of Comrie, and along the *ſtrath* on the ſouth ſide of the river. The limits of the leſſer concuſſions, I am confident, do not extend above three miles in any direction

rection from their centre. They are commonly obſerved at Lawers on the eaſt; throughout the whole of Glen-Leadnach, at Dunira, Dalchonzie and Aberuchill, on the north and weſt; and do not reach ſo far as the *manſe*, which is about three quarters of a mile on the ſouth of Comrie*.

I am, with great regard,

DEAR SIR,

Your's moſt ſincerely,

RALPH TAYLOR.

POSTSCRIPT.

Duddingſtone Houſe, Jan. 24. 1793.

THERE is no reaſon to believe, that theſe phenomena are yet come to an end. After temporary intermiſſions, ſometimes of ſeveral months, they have returned, ever ſince their firſt appearance in 1789, without any apparent difference in their extent

* THE tract within which the concuſſions deſcribed in this letter appear to have been confined, is a ſpace of a rectangular form, which extends from eaſt to weſt along the north ſide of the Earn about 22 miles in length, by a little more than five in breadth; reckoning the utmoſt length from about Monzie to the head of Loch Tay, and the breadth from a little ſouth of the Earn northward to the ridge which ſeparates the branches of that river from thoſe of the Almond. The whole of this tract is mountainous, except toward the eaſtern extremity, where it joins the low country, and on the banks of the river Earn on the ſouth. It is interſected by narrow glens or valleys, the moſt conſiderable of which is Glen-Leadnach, where the centre of the concuſſions ſeems to be placed. The mineralogy of this part of the country has not hitherto been accurately examined; but it is known in general, that the ſtone is the primary ſchiſtus, and in ſome places granite; that no mineral veins, nor any hot ſprings, have been found in it, and that no volcanic appearances have been obſerved. In the valleys, among the mountains, iron ore, of the kind that is called bog ore, is ſaid to abound. Dr HUTTON has remarked, that the line which terminates this tract on the S. E. ſeems to be nearly the ſame with that where the primary ſtrata ſink under the ſurface, and are covered by the ſecondary, or horizontal ſtrata. J. P.

extent or force. The rumbling noifes or flighter concuffions, as ufual, are obferved at Comrie, in Glen-Leadnach, and the places in their near neighbourhood; the more violent extend to much the fame diftance as formerly defcribed. Having been only occafionally in that country fince February 1791, I have not been able to afcertain dates. On the 2d of September 1791, at five minutes paft five in the afternoon, a flight fhock was felt at Ochtertyre. The barometer was not in order, on which account the weight of the atmofphere could not be afcertained. Its electrical ftate was tried by SAUSSURE's electrometer, but no indication of any thing uncommon was perceived. Since that period, fhocks have been obferved at different times till within thefe few weeks paft.

FROM this account, it will be obferved, that all the greater fhocks have taken place in the feafon of autumn or the beginning of winter; that this has been now repeated for more than four years; and that thofe greater fhocks have been fucceeded at fhort intervals by rumbling noifes or more feeble concuffions. It has alfo been remarked, that they have in general been preceded or followed by great rains or boifterous weather; but variations in the weather take place fo frequently in our climate at that feafon of the year, that the connection between them and the phenomena above defcribed, is probably altogether accidental.

R. T.

XII. *A* DESCRIPTION *of an* IMPROVED THERMOMETER. *Communicated by DANIEL RUTHERFORD,* M. D. F. R. S. EDIN. *Professor of Medicine and Botany in the University of Edinburgh.*

[*Read April* 5. 1790.]

THE following improvement on the construction of the thermometer, by which it is fitted to mark the lowest or the highest point to which the fluid has attained in the absence of the observer, is due to JOHN RUTHERFORD, M. D. of Middle Balilish. This gentleman communicated it to me some time ago, and accompanied the description with one of his thermometers. The contrivance is so very simple and ingenious, that it well deserves to be made public. I therefore, by permission of the author, beg leave to lay an account of it before the Royal Society.

1. IF it be required, that the thermometer should mark the lowest point to which the liquid has descended within any given time, a common spirit of wine thermometer must be provided, of a convenient size, such as is represented by the figure A B *. Into the tube is introduced a small conical piece of coloured glass or enamel, (C), with its point turned towards the bulb of the thermometer. This piece is about ½ inch long, and of such diameter at the base, that it may move freely within the tube, yet

* See the figure, plate 4. at the end of No. XIII.

yet nearly fill the caliber. It is to be allowed to move downwards till it be fully immerfed in the fpirit. After this has once been effected, it will be found, that it is not difpofed to part again from the fpirit; but if the thermometer be held vertically, with the bulb uppermoft, it will immediately defcend to the extremity of the column but no farther: There it refts; and if by a diminution of heat the fpirit contract, it is drawn upwards at the extremity of the column, as this recedes towards the bulb. Now, let the thermometer be fo difpofed, that its ftem, inftead of being vertical fhall be horizontal, (and fuch is the ordinary pofition of this thermometer), it may readily be imagined, that, in this cafe, the conical piece fhall equally, as before, follow any retraction of the column; but fhould this lengthen again, in confequence of an increafe of temperature, the conical piece does not advance with it, but remaining fixed at the loweft point to which the column had defcended, it allows the liquor to pafs freely beyond it, as that again expands. Hence the point of the fcale at which the conical piece is found to reft, denotes the loweft degree to which the liquor of the thermometer has funk in the interval of the obfervations. To rectify the inftrument for a frefh obfervation, nothing farther is requifite than to elevate the bulb of the thermometer, in order that the conical piece may fink, by its proper gravity, to the extremity of the column.

2. If it be required, that the thermometer fhould mark the higheft point to which the fluid has afcended in any given time, then a mercurial thermometer is to be employed, fuch as is reprefented by D E; into the tube of which is introduced a conical piece of ivory F, with its bafe turned towards the bulb. When fuch a thermometer is placed in a vertical fituation, the bit of ivory will fall down, and reft upon the furface of the mercury in the tube; it will rife as the column is lengthened, and defcend as this contracts. But if the ftem be

placed

placed horizontally, though the ivory will be equally puſhed forwards by the mercury, while this is expanded by an increaſe of temperature, yet ſhould the mercury again contract, the ivory will not follow it, but remain ſtationary, and conſequently the point at which it reſts will mark the higheſt degree to which the thermometer had riſen. An inſtrument of this kind is rectified by bringing the ſtem into a vertical ſituation with the bulb undermoſt, then cautiouſly reſtoring it to a horizontal ſituation.

Two thermometers ſuch as thoſe above deſcribed, one filled with ſpirit of wine, and the other with mercury, may conveniently be diſpoſed upon one frame. If their bulbs be ſituated at the oppoſite ends of the frame, or as repreſented by the figure, then both may be rectified by the ſame movement, and we ſhall have an opportunity of aſcertaining, by the ſituation of the conical pieces in the different ſtems, both the higheſt and the loweſt point which the fluids of the thermometers have reached during any interval of our obſervations.

XIII. OBSERVATIONS *on the* MUSCLES; *and particularly on the Effects of their* OBLIQUE FIBRES. *By ALEXANDER MONRO,* M. D. F. R. S. EDIN. *Professor of Medicine, Anatomy and Surgery in the University of Edinburgh, Fellow of the Royal College of Physicians in Edinburgh, and of the Royal Academy of Surgery in Paris.*

[*Read Jan.* 7. 1793.]

AS it appeared to me, when I first began, in 1759, to deliver in this University a public course of lectures on Anatomy and Surgery, that the structure of the oblique muscles had not been sufficiently examined, nor even the number of them attended to by authors, and that some of their chief purposes or effects had been entirely overlooked by them, I endeavoured then, and in every course of lectures since that time, to direct very particularly the attention of students to those subjects.

I BEGAN with observing, as a material defect in the otherwise very accurate and elegant tables of ALBINUS, as well as in the former systems of VESALIUS, EUSTACHIUS, BIDLOO and COUPER, that the tendinous membranes or apaneuroses, with which many muscles, particularly of the extremities, are covered, and with which the oblique muscles are closely connected, were not delineated, yet that the knowledge of these is not only of use in the practice of surgery, but for understanding the action of the muscles.

I

I REMARKED, that although in ſome parts of the body, tendinous membranes, ſuch as thoſe between the cartilages of the ribs, or the apaneuroſes palmares, or faſciæ latæ of the thighs, ſerved merely for the defence of the parts, or as ſheaths to them, as they were connected to them by the cellular ſubſtance only, yet, in general, they ſerved, beſides the mere purpoſe of defence, to furniſh a greater extent of ſurface for the attachment of oblique fleſhy fibres.

I SHEWED them, that wherever tendinous membranes run longitudinally on the ſurfaces of muſcles, fleſhy fibres, placed obliquely, were found; that in many muſcles, as in the ſemimembranoſus, or flexor pollicis longus, fleſhy fibres paſſed obliquely from the inner part of the tendon on one ſide, to the inner part of the tendon on the other ſide of the muſcle, or ſuch muſcles were ſemi-penniform, (See T. 1. fig. 1.); that in other muſcles, as in the rectus extenſor cruris, or flexor pollicis pedis longus, a third tendinous membrane was found in the middle of the muſcle, between which and the inner parts of the tendons on the two ſides of the muſcle, the fleſhy fibres paſſed obliquely, and produced a complete penniform appearance, (ſee T. 1. fig. 2.); and ſome muſcles, as the ſoleus, might be called compound penniform, becauſe, on cutting them lengthways, we diſcovered ſeveral longitudinal tendinous membranes, to both ſides of which oblique fleſhy fibres were connected. See T. 1. fig. 3.

I ALLEGED, that the direction, length and number of fibres in ſuch muſcles had not been ſufficiently attended to by anatomiſts or by ſurgeons; and that, in many inſtances, the breadth of theſe muſcles had been miſtaken for their length; that in conſequence of ſuch inattention, they would find the celebrated LOUIS * attempting to diſcard the double inciſion of the ſoft parts in the amputation of the thigh, although, from the obliquity and ſhortneſs of the muſcular fibres which cover

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* Acad. Roy. de Chirurg. T. 2. p. 357.

the thigh-bone, this improvement of CHESELDEN is more eſſential than in the amputation of the humerus, where the fleſhy fibres, though oblique, are proportionally longer, and of courſe their retraction greater.

WHERE the fibres of muſcles run obliquely, it is evident, and has been obſerved by BORELLUS and others, that the fibres will be more numerous than if the ſame ſpace had been covered with longitudinal fibres; and although an oblique fibre will not raiſe a weight with the ſame force as a ſtraight fibre, yet the number of the fibres may be ſo much increaſed by their obliquity, as to do more than compenſate for the loſs of force occaſioned by the obliquity. Thus, let us ſuppoſe a longitudinal muſcle to be five inches long, and one inch in breadth, and let us ſuppoſe it to contain in its breadth four fibres or ropes, each one-fourth of an inch in diameter, as in T. 2. fig. 1. the force of this muſcle may be repreſented by the number 4.

LET us next ſuppoſe theſe ropes to be cut into pieces, each of which is one inch and a quarter in length, as repreſented by dotted tranſverſe lines A, B, C, we ſhall, by doing ſo, form 16 ropes or fibres.

LET us next ſuppoſe, that theſe ropes, repreſenting muſcular fibres, are laid obliquely, like the hypotenuſes of right-angled triangles, of which the baſes are equal to one inch, and the height or perpendicular equal to three quarters of an inch, as in T. 2. fig. 2. each ſuch fibre will, as BORELLUS has demonſtrated, loſe two-fifths of its force. But as there are 16 fibres inſtead of 4, their force will be as 16 multiplied by 3, to 5 multiplied by 4, or as 48 to 20, or as 12 to 5.

BUT that the mere increaſe of the number of fibres, or force of the muſcles, which alone has been obſerved by authors, is not the ſole purpoſe of nature, appears from this, that in ſome places, and particularly between the ribs, oblique fibres are employed, although it is evident, that a greater number of ſtraight

ſtraight fibres, or of fibres perpendicular to the ribs, might have been diſpoſed in the ſame ſpace.

THE other purpoſes of oblique muſcles, and which had not been perceived by authors, are,

To perform much more extenſive motions with the ſame degree of ſhortening of the fleſhy fibres, than can be performed by ſtraight muſcles, or, with a leſs degree of ſhortening of the fibres, to perform motions of equal extent.

I SHALL now endeavour, in the firſt place, to demonſtrate, that a pair of oblique muſcles, placed between the ſame parallels with two ſtraight muſcles, perform, with the ſame proportional contraction, more extenſive motions than the ſtraight muſcles can do.

FIRST, As one oblique muſcle, ſo ſituate, is longer than a ſtraight muſcle, if each be ſhortened one third, or any other proportional part, it is evident, that the place of the inſertion of the muſcle will move through a greater ſpace, when the oblique muſcle acts. Thus, in the annexed figure, (T. 2. fig. 3.) if P, L repreſent two parallel lines, and A B repreſents an oblique and A C a ſtraight muſcle, it is plain, that when each is ſhortened one third, and that the place of the inſertion is moved directly towards the place of the origin of the muſcle, the motion occaſioned by the oblique muſcle will be proportionally as much greater than that produced by the ſtraight muſcle, as the hypotenuſe, or line A B, is longer than the perpendicular line A C.

BUT next, let us ſuppoſe, (ſee T. 2. fig. 4.) that the point A cannot be drawn directly towards the point D or E, on account of the connections of the bones, ſuch as the ribs, which the parallel lines P A and D E repreſent; or ſuppoſe, that ſuch bones, when moving, remain parallel to each other; or let us ſuppoſe, that two oblique muſcles balance each other, ſo that their inſertions, inſtead of being moved directly towards their origins, are moved in a diagonal line, between the two muſcles.

THUS,

Thus, let P A and D E (T. 2. fig. 4.) be two parallel lines, and let A B and A C reprefent two ftraight mufcles, and AD and AE two oblique mufcles, it is plain, that when the two ftraight mufcles have fhortened themfelves one third part of their length, their infertion A will be brought down to number 1. But when the oblique mufcles A D and A E, by acting together, have brought the point A down to 1, and are in the fituation of the dotted lines 1D and 1E, they cannot have loft more of their length than the length of the perpendicular A1, which is fhorter than the hypotenufe *Ab*, or lefs than the third of the length of the oblique mufcle. In fact, they have loft lefs of their length than A1, becaufe the two fides A1 and 1E of the triangle A1E muft be longer than the third fide A E; and therefore oblique mufcles can perform as great a degree of motion as ftraight mufcles, without being fhortened in the fame proportion; or, which is the fame thing, if they continue to act till they are fhortened in the fame proportion, the place of their infertion, A, will defcend farther, or through a larger fpace.

I shall now proceed a ftep farther, and endeavour to demonftrate, that where two oblique mufcles balance each other, the motion of their infertion is more extenfive than can be produced by two ftraight mufcles of the fame length with the oblique mufcles.

Thus, in T. 2. fig. 5. let A B and A C reprefent two ftraight mufcles, and A D and A E two oblique mufcles of the fame length, and we fhall fuppofe the length of each mufcle to confift of any given number of inches or parts, fuppofe five parts, 1, 2, 3, &c. or I, II, III, &c. and when in action to be capable of fhortening itfelf one fifth part or two fifth parts of its length. Let the two correfponding numbers 1 and I, or 2 and II, be joined by the ftraight lines 1 I, and 2 II, fo as to form the ifofceles triangles A 1 I, or A 2 II. When the two ftraight mufcles

muſcles have acted fully, or ſhortened themſelves one-fifth of their length, the point A will deſcend to 1. But when the two oblique muſcles have, by their action, brought the point A down to 1, they have not loſt one-fifth of their length; for the dotted lines repreſenting them muſt be longer than the lines I E or I D, becauſe the angle 1 I E being equal to the two angles 1 I A and 1 A I of the iſoſceles triangle A 1 I, muſt be larger than a right angle, and therefore the ſide 1 E muſt be longer than the ſide I E; that is, the oblique muſcles, after bringing the point A down to 1, have not loſt one-fifth of their length; or if they continue to act till they have loſt one-fifth of their length, they will bring the point A lower down than can be done by ſtraight muſcles, ſhortened in the ſame proportion.

To make this propoſition ſtill plainer, if poſſible, by calculation, I ſhall ſuppoſe the oblique and ſtraight muſcles in T. 2. fig. 6. to be each five parts or five inches in length; that the baſes of the triangles B D and C D meaſure four inches; and that the perpendiculars, or altitudes of the triangles, meaſure three inches; and let it be ſuppoſed, that theſe muſcles, in action, can be ſhortened one-fifth of their length, the ſtraight muſcles, on that ſuppoſition, can bring A down to 1 only: But it is evident, that the oblique muſcles will not be ſhortened one-fifth of their length till the point A has deſcended to D, or to number 3; or the oblique muſcles will, with the ſame degree of contraction, move the point A three times farther than can be done by ſtraight muſcles of the ſame length.

In the next place, we may eaſily demonſtrate, that the extent of the motion produced by the co-operation of oblique muſcles, increaſes with their greater degree of obliquity.

Thus, let us compare the extent of motion, produced by the pair of oblique muſcles A D and A E, (T. 2. fig. 5.) with that

that of the ſtill more oblique pair of muſcles repreſented in the ſame figure by the lines 1 D and 1 E. Let the muſcles A D and A E be ſuppoſed to move the point A to number 1, and let the muſcles 1 D and 1 E be ſuppoſed to move number 1 to number 2, or through a like ſpace. It is evident, that in the triangles 1 I E and 2 II E, the angles 1 I E and 2 II E are equal; but as the angle 2 E II is larger than the angle 1 E I, the angle II 2 E muſt be leſs than the angle I 1 E. Hence, as the ſides of triangles are longer in proportion to the width of the oppoſite angles, the ſide I E will be longer in proportion to 1 E, than the ſide II E is in proportion to 2 E. The muſcular fibres, therefore, A D and A E, in bringing the point A down to number 1, will loſe more, in proportion of their length, than the more oblique fibres 1 D and 1 E will do in moving number 1 to number 2.

To prove this by calculation, let us ſuppoſe the muſcle to be ſtill repreſented by the hypotenuſe of a right angled triangle, five inches in length, and capable of ſhortening itſelf one inch, and that one of the other ſides meaſures four inches, and that the third ſide meaſures three inches. But let the ſide 3 form the baſis of the triangle, and the ſide 4 its perpendicular, as in T. 2. fig. 7.

In this caſe, the ſquare of the hypotenuſe, when it has ſhortened itſelf one inch, will be 16, from which deducting 9, the ſquare of the baſis, the number 7 remains for the ſquare of the perpendicular. But the ſquare root of that number being more than $2\frac{1}{2}$, the oblique muſcles, ſhortened one-fifth, cannot bring the point A down $1\frac{1}{2}$ inch, or to B, or cannot move the point A half ſo far as they were ſhewn to do, when the obliquity was greater, by making the baſis 4 inches and the altitude 3 inches.

Or let us, on the other hand, increaſe the obliquity, as in T. 2. fig. 8. by ſuppoſing two right-angled triangles, ſo con-

ſtructed, as that their hypotenuſes meaſure 13 inches, their baſes 12, and altitude 5 inches, and that the hypotenuſes repreſent two oblique muſcles. It is plain, that when theſe have ſhortened themſelves one inch, or one thirteenth part of their length, they will move the point A through a ſpace of five inches, or five times farther than ſtraight muſcles of the ſame length, ſhortened in the ſame proportion, could do.

Hence, as the obliquity of an oblique muſcle is gradually increaſing during its action, its force is diminiſhing; while its effect, of producing extenſive motion, is increaſing. Thus, a muſcle, repreſenting the hypotenuſe of a right-angled triangle, whoſe ſides are to each other as the numbers 3, 4 and 5, and the altitude 3, by ſhortening itſelf half an inch, does not move its inſertion one full inch; but if it is ſhortened another half inch, its inſertion is moved through a ſpace of upwards of two inches more. When it begins to act, it has three-fifths of the ſtrength of a ſtraight muſcle of the ſame ſize; but when it acts again, after having moved its inſertion the ſpace of an inch, it has two-fifths only of the ſtrength of the ſtraight muſcle.

To illuſtrate what I have been demonſtrating, I uſed, after diſſecting and demonſtrating the recti muſcles of the abdomen, to cut their ends off from the oſſa pubis, and to apply them to the tops of the oſſa ilia, ſo as to repreſent oblique muſcles; and from this I was led to make the remark, that if both the two external oblique, or the two internal oblique muſcles, or all theſe, acted at once, the obliquity of the one balancing the obliquity of the other, the trunk of the body would be bended ſtraight forwards, and that flexion made by them might be greater than that made by the recti muſcles, which, at firſt ſight ſeemed to be more ſuited to the purpoſe.

In like manner, I uſed to take out ſeveral of the ribs, with their intercoſtal muſcles; and after ſhewing the two layers of

theſe muſcles laid obliquely, and decuſſating each other, I uſed to diſſect ſome portions of the two layers, in ſuch a manner as to repreſent oblique muſcles, with their origins at a diſtance from each other, but their inſertions meeting in a point, or with their inſertions, as well as their origins, at a diſtance from each other.

In the back part of the ſpine, I very particularly demonſtrated the obliquity of many of the muſcles, ſome of which are called ſemiſpinales, becauſe one end of them only is fixed to the ſpinal proceſſes, and the fibres paſſing obliquely, the other end of them is fixed to the tranſverſe proceſſes, or other parts of the neighbouring vertebræ.

In the extremities, I not only carefully demonſtrated the obliquity of the fleſhy fibres, in the half and whole penniform muſcles, but pointed out their connection with their tendinous aponeuroſes, the different direction of the tendinous and fleſhy fibres, and the uſes of the aponeuroſes and tendinous ſheaths; and that, by means of the ſheaths, there was ſo little difference between the length of the muſcles in the bended and extended ſtate of the member, that ſhort fleſhy fibres, eſpecially when placed obliquely, could produce a very extenſive motion.

But in treating of particular parts, I dwelt chiefly on the ſtructure and effects of the intercoſtal muſcles, as a variety of opinions concerning their operation has, in the courſe of the laſt hundred years, been propoſed, and as no author had explained the reaſon of the obliquity of their fibres, nor of their being diſpoſed in two layers of decuſſating fibres.

That their ſtructure might be fully underſtood, I firſt laid bare the ſurface of the external intercoſtal muſcles, and between the next two ribs, I cut off the external intercoſtals, to ſhew the internal, as in T. 3. fig. 4.

In another ſpace, I ſhewed a ſmall bundle of the external intercoſtal, decuſſating a ſimilar bundle of the internal intercoſtal,

coſtal, and forming a figure like the letter X, but in which the ſtroke repreſenting the external muſcle is more oblique than the other; for the internal intercoſtals are leſs oblique than the external. See T. 3. fig. 5.

Then I diſſected ſmall bundles of the external and internal intercoſtals, with their origins at a diſtance from each other, but their inſertions meeting in a point, in the rib above or in the rib below, ſo as to form triangles, of which the rib made the baſe, (ſee T. 3. fig. 6. and 7.); or I diſſected them with their inſertions, as well as their origins, at a diſtance from each other, as in T. 3. fig. 8.

In the laſt place, I demonſtrated a part of the ſtructure which has not been ſufficiently examined by authors; to wit, that the cartilages between the ribs and the ſternum, with the exception of the cartilage of the firſt rib, are not fixed to the ſternum in the ſame manner as to the ribs; for the rib, which is hollowed, receives the cartilage, and is ſo firmly united to it, that in a recent ſubject, they cannot be ſeparated without lacerating the cartilage; but the inner part of the cartilage is tied by a capſular ligament to the edges of the pit in the ſternum, and the concave part of the pit is connected by fine cellular threads only to the end of the cartilage, ſo that the cartilage and ſternum may, after cutting the capſular ligament, be ſeparated from each other without tearing the cartilaginous fibres. Hence, when the ribs are moved, the capſular ligament is twiſted, and the end of the cartilage rolls upon the ſternum. See T. 3. fig. 1, 2, 3. and 9.

After fully explaining the ſtructure, I endeavoured to prove, as Dr Haller had done, but with ſome additional arguments, that both rows of intercoſtal muſcles conſpired to elevate the ribs, or that they were muſcles of inſpiration; and that, when the intercoſtal muſcles alone acted, and the ribs were not forcibly kept down, they could have no other effect;

 and

and that all the ribs in inſpiration were moved upwards uniformly.

The chief circumſtances which prove beyond a doubt, that the two rows of intercoſtal muſcles conſpire in elevating the ribs, are,

1. That the firſt rib is ſo much fixed at both its ends as to be almoſt immoveable, and its cartilage, inſtead of being connected to the ſternum by a capſular ligament or articulated with it in the ſame manner as the cartilages of the other ribs, grows as firmly to the ſternum as to the rib. See T. 3. fig. 9.

2. That the ſecond rib is more fixed than the third, and the third more fixed than the fourth, and ſo on downwards.

3. That as the ribs, from the firſt rib downwards, grow gradually longer, and deſcribe portions of larger circles, we may obſerve, that in general, or when we examine a middle portion of the intercoſtal muſcles, or a portion half-way between the ſternum and vertebræ, the inſertion of the lower end of the portion is at a greater diſtance from either end of the lower rib, or from a ſtraight line drawn between the two ends of that rib, than its origin in the rib above is from the two ends of that rib, or from a ſtraight line drawn between them. Hence, whether we conſider the head of the rib, connected with the vertebræ as its centre of motion, or whether we conſider the rib as moving upon a ſtraight line or axis drawn between its two ends, it follows, that a muſcle placed between two ribs acts with a longer lever upon the under rib than upon the upper one, and therefore muſt elevate the under rib. That the force of this argument might be more readily underſtood, I have laid leaden probes along each of the ſeven uppermoſt ribs of an adult ſubject, from the vertebræ to the ſternum, and have repreſented their lengths and curvatures in T. IV. The crooked continued lines repreſent the lengths and curvatures of the different ribs and their cartilages. The ſtraight dotted lines repreſent the diſtances

diſtances between their heads and the ſternum. The continued perpendicular line repreſents the diſtance of the middle of each rib from a ſtraight line drawn between its two ends. The numbers 1, 2, 3, 4, 5, 6, 7, expreſs firſt, ſecond, &c. ribs, of which the firſt is the ſhorteſt and innermoſt, and the ſeventh the longeſt and outermoſt. The other numbers annexed denote eighths of an inch.

4. To determine the effect of the contraction of any muſcle, I apprehend, we need only to obſerve in the dead body what the ſituation is in which the muſcle in queſtion is relaxed. Applying this rule, we ſhall find, that the whole intercoſtal muſcles, internal as well as external, are ſhortened when we elevate the ribs and place them in that ſituation in which we find they are in inſpiration.

5. If the internal intercoſtal muſcles had been intended for the depreſſion of the ribs, we certainly ſhould not have found them continued to the ſternum, becauſe their anterior ends are fixed above to the edge of the ſternum, or ſo near to the inſertion of the cartilage of the upper rib in the ſternum, and their inferior ends are, in conſequence of their obliquity, fixed to the under rib ſo much farther from the ſternum, that they muſt act upon the under rib with more advantage of lever, or are intended for its elevation.

On the other hand, if the internal intercoſtals had been intended for the depreſſion of the ribs, we certainly ſhould have found them continued backwards to the ſpine, becauſe, from their obliquity, their under end would have been fixed to the vertebræ or nearer to the head of the rib, and their upper end at ſuch a diſtance from it, that this portion of the muſcle would have been better calculated than any other portion of it for the depreſſion of the rib.

6. In a few experiments which I made on living animals, ſoon after I began to ſtudy anatomy, and which I repeated afterwards, particularly in 1770, I ſaw plainly, as Dr Haller had done,

done, that both rows of intercoſtal muſcles were in action during inſpiration.

After proving, that both rows of intercoſtal muſcles conſpire in elevating the ribs. I uſed to point out the fallacy of the demonſtrations, by which Bayle, Hambergerus, and others, have pretended to prove, that the internal intercoſtal muſcles depreſs the ribs. The machine they deſcribe as repreſenting the ribs, vertebræ and ſternum, reſembles very exactly two wooden rulers A. B, kept parallel by two pieces of braſs, C and D, ſuch as are uſed for drawing parallel lines; and the two layers of the intercoſtal muſcles are repreſented by the threads EF and HG, paſſing obliquely from the one ruler to the other, and decuſſating each other. See T. 2. fig. 9.

Let C, one of the pieces of braſs, repreſent the vertebræ, and the other piece D the ſternum. Let A repreſent the uppermoſt rib on the right ſide of the body, and B the ſecond rib. Let EF repreſent the external, and HG the internal intercoſtal muſcle.

Then, let C, repreſenting the immoveable vertebræ, be held faſt, and let EF be pulled or ſhortened, they tell us, that the ſecond rib B muſt be more affected than the firſt, becauſe the lower end of the muſcle being at a greater diſtance from C than the upper end of it, the muſcle will act upon the ſecond rib with a longer lever, and therefore that the external intercoſtal muſcles muſt elevate the rib.

But when the internal intercoſtal muſcles, repreſented by HG, are ſhortened, they obſerve, that matters will be reverſed; and as their origin in the firſt rib is farther from the vertebræ, or centre of motion, than their inſertion in the ſecond rib, that having a longer lever, they muſt ſerve to pull the firſt rib down.

Accordingly, the rulers, on pulling alternately the threads EF and HG, will be moved alternately upwards and downwards.

But

But to ſhew the fallacy of this, I need only to add to what has been before obſerved, that we can perform a full inſpiration, without bringing the upper rib, or top of the ſternum, upwards or nearer to our head; whereas the pretended demonſtration reſts entirely on the ſuppoſition, that all the ribs, not excepting the firſt and ſternum, have a large play upwards and downwards alternately. Stop the play of the firſt rib, or ſuppoſe it to be fixed in its place, which is the fact, and the boaſted demonſtration is annihilated.

The late opinion of Sabatier *, that both rows of intercoſtal muſcles ſerve for expiration, and that the ribs are elevated by the ſcaleni and ſerrati poſtici ſuperiores, which are fixed to a few only of the upper ribs, ſcarcely merits a comment. It is refuted by what is above mentioned, and by the want of the external intercoſtals near to the ſternum, and of the internal near to the ſpine; for intercoſtals at thoſe places would have ſerved to depreſs the ribs more powerfully than in any other part of the thorax.

Let us now conſider the purpoſe,

First, Of the obliquity of the fibres in the intercoſtal muſcles, and,

Secondly, Of their being diſpoſed in two layers, the fibres of which decuſſate each other.

It is evident, that the obliquity of the fibres here is not intended to increaſe their number, or the ſtrength of the muſcle, becauſe the fibres would have been more numerous if they had paſſed directly from the one rib to the other, or had been inſerted into the ribs at right angles.

I apprehend, therefore, that we are to explain the reaſons of the ſtructure in the following manner:

Nature, in order to give protection to the heart and lungs, has formed the ribs as broad and flat as poſſible, or left no more ſpace between them than is required for lodging muſcles for

* See Anatom. T. 3. p. 465. 7. m.

for their motion in refpiration. Confiftently with this view, as the ribs are fixed at both ends, fo that they cannot be moved backwards and forwards, but are confined to motion upwards and downwards, remaining nearly parallel to each other, oblique mufcles are preferred to ftraight; for if the former can, as I have before demonftrated, perform more extenfive motion than the latter, even where both are of the fame length, they muft have a ftill greater effect, where the two kinds of mufcles are confined between the fame parallels.

Thus, fuppofe the direct diftance, or perpendicular drawn from one rib to another, to be reprefented by three parts, and that the intercoftal mufcle, in confequence of its obliquity, meafures five fuch parts, and that each of thefe is capable, when in action, of fhortening itfelf one-fifth part of its length; it appears from the demonftration, that the oblique mufcle can move the rib through a fpace five times greater than the ftraight mufcle can do.

On accurate menfuration, I found the length of the intercoftal mufcle to be one inch and a half, the perpendicular line one inch, and the bafe about one and one-eighth inch. Hence, calculating on the fuppofition, that the mufcular fibre, in action, fhortens itfelf one-fifth of its length, it will be found, that the intercoftal mufcles, in confequence of their obliquity, produce a greater motion of the ribs than perpendicular mufcles could have done, nearly in the proportion of 35 to 12.

The only point remaining to be explained, is, why nature hath formed two layers of intercoftal mufcles decuffating each other.

The purpofe of this, I apprehend, is to render the motion of the rib upwards as direct as poffible, and to prevent it from being drawn or preffed forwards upon the fternum, or backwards upon the vertebræ, fo much as, by its friction, to interrupt the freedom of its motion.

Tab.1.

Tab I

Fig. 1

Fig. 2.

Fig. 3

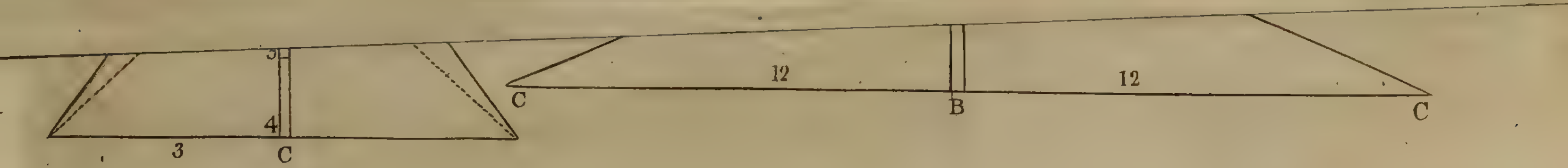


Fig:IX.

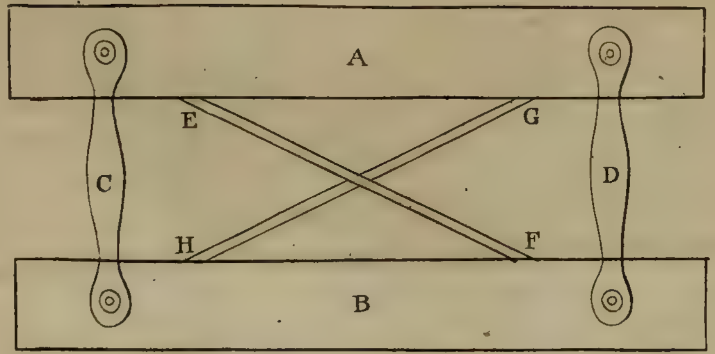
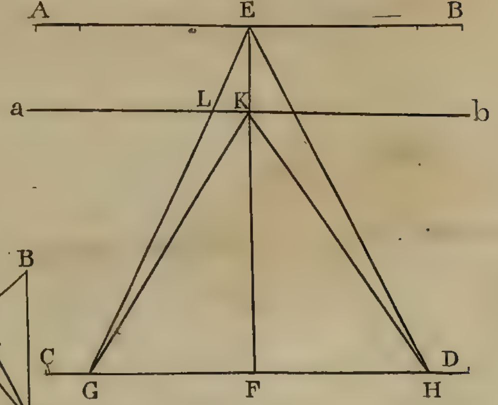


Fig:X.



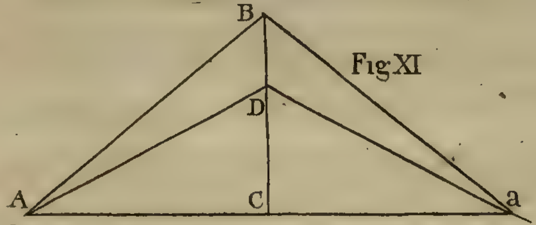


Fig:XI

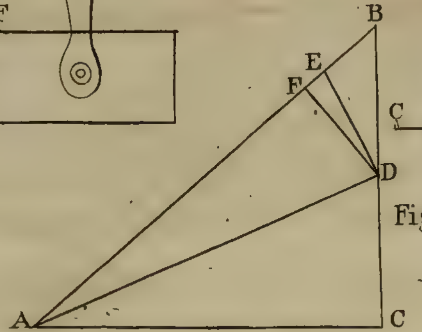


Fig:XII

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Tab. II

Fig. I

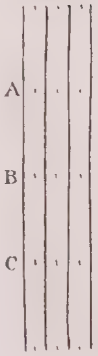


Fig. II

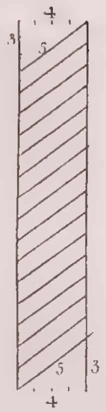


Fig. III

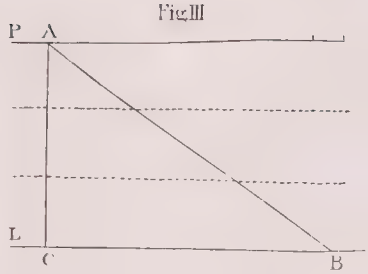


Fig. IV.

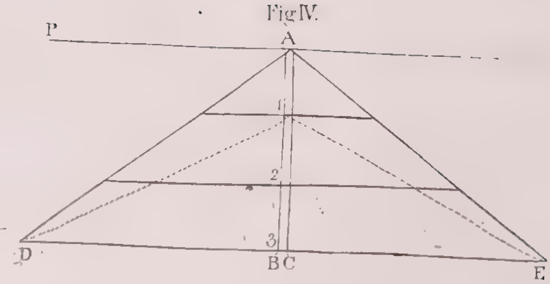


Fig. V.

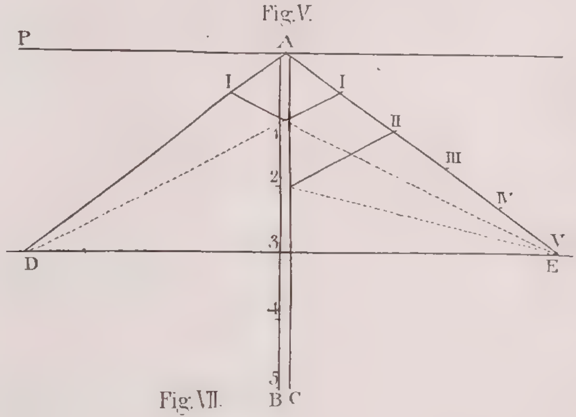


Fig. VI.

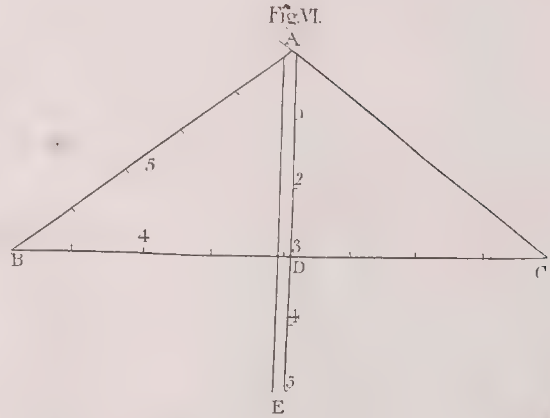


Fig. VII.

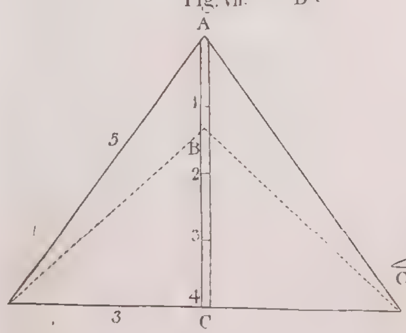


Fig. VIII.

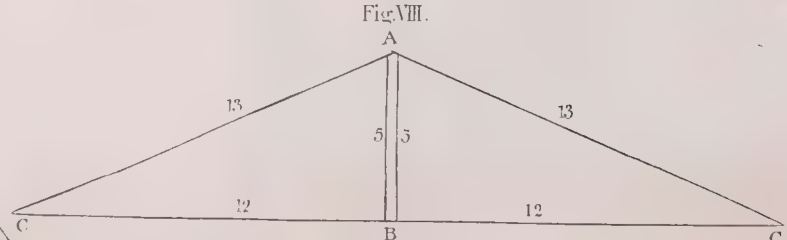


Fig. IX.

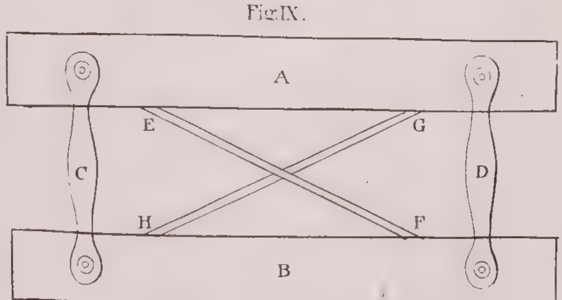


Fig. X

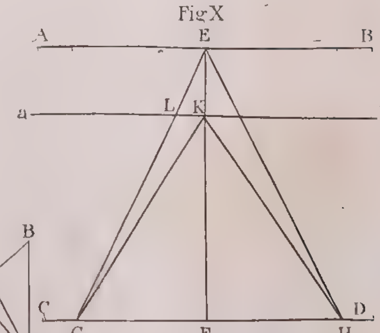


Fig. XI

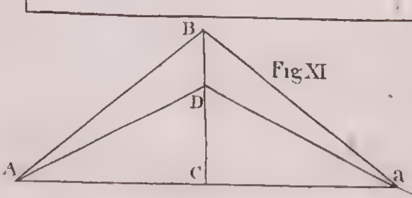
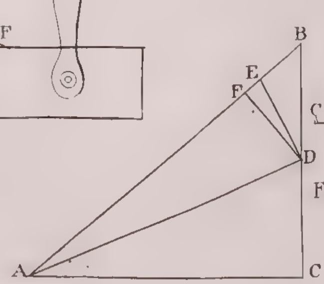


Fig. XII



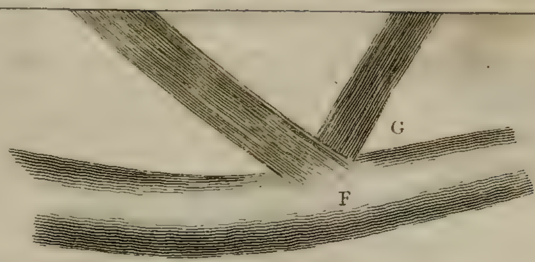


Fig. 7.

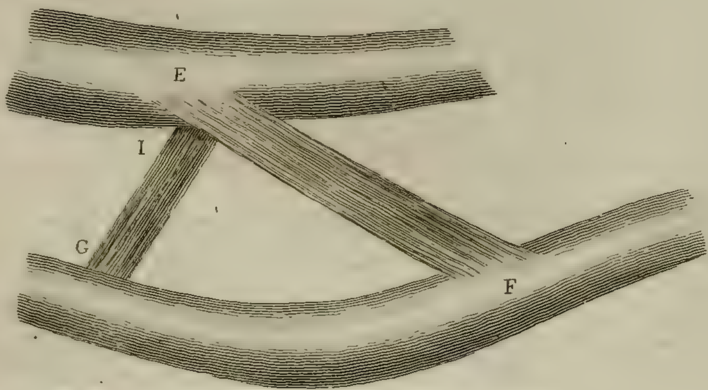
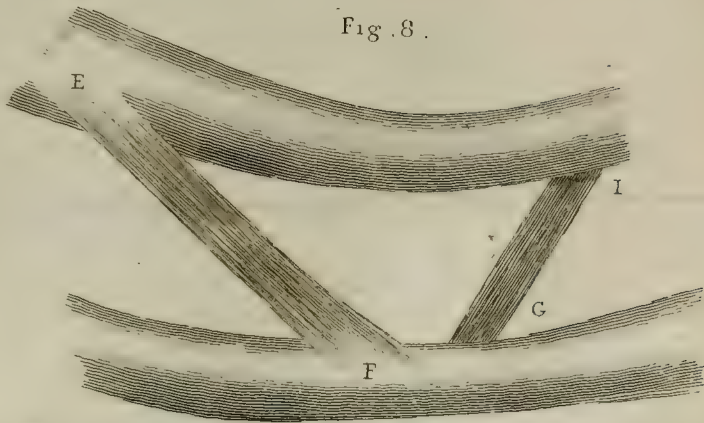


Fig. 8.



J. Fyfe del.

Tab. III

Fig 1

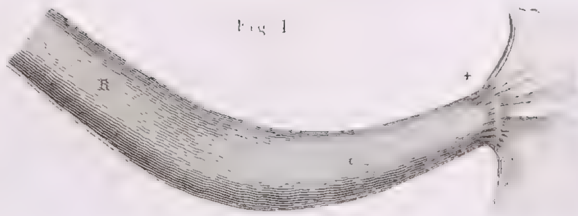
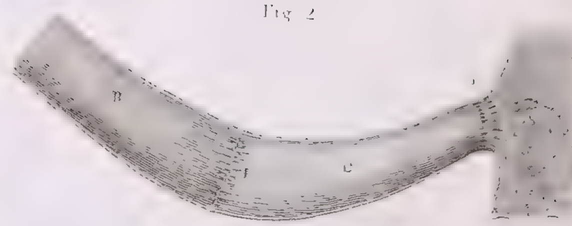


Fig 2



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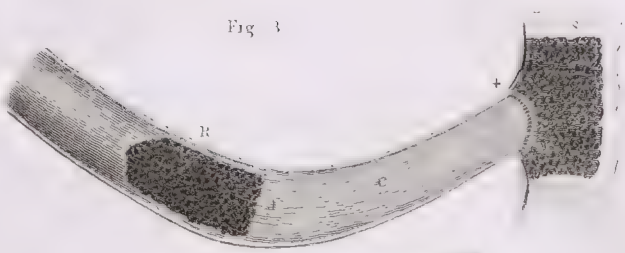

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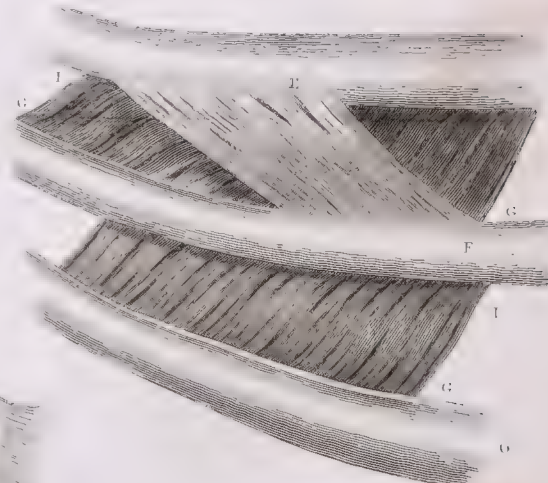


Fig 9

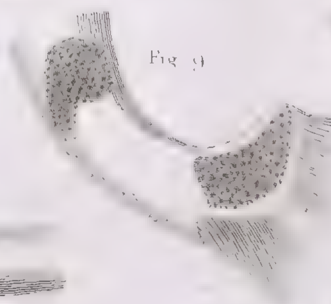


Fig 5

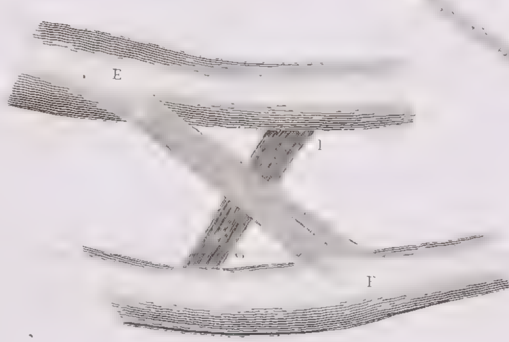


Fig 6

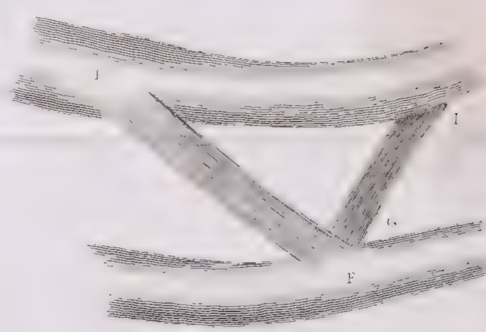


Fig 7

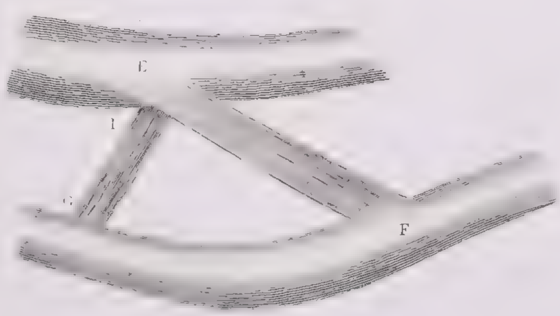
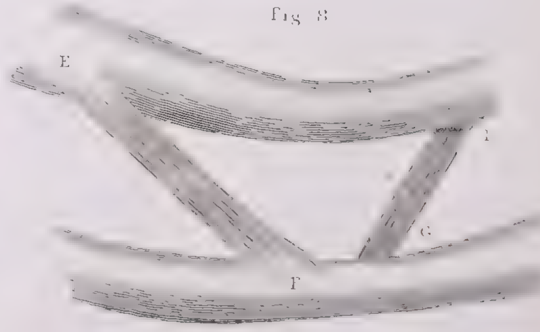


Fig 8



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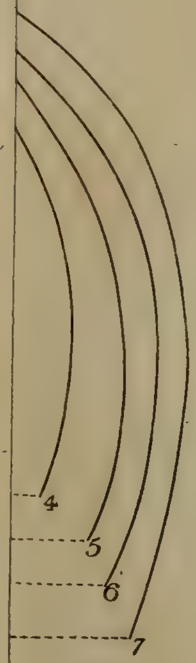
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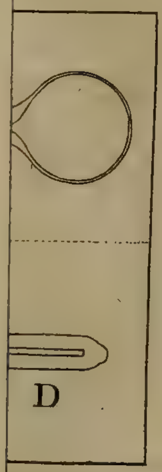
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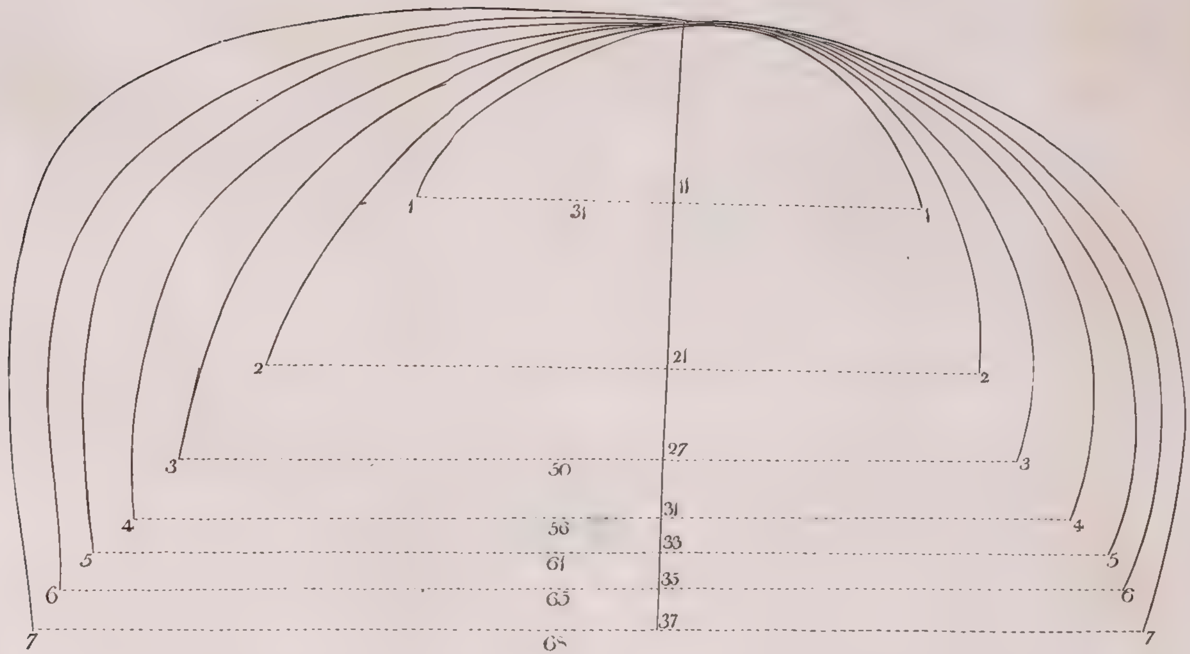
TAB. VI.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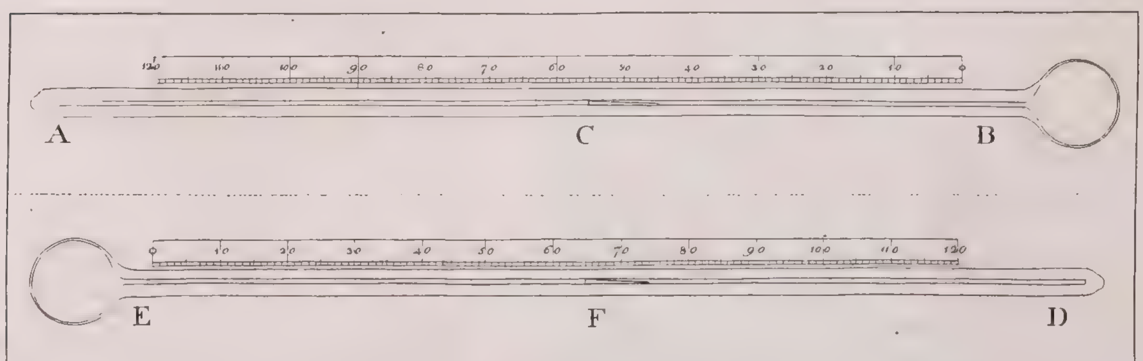
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Upon the whole, by the obliquity of the intercoſtal muſcles, the motion of the ribs is very much greater than could have been performed by ſtraight muſcles placed between them: At the ſame time, by their conſiſting of two layers, or two muſcles decuſſating and balancing each other, the motion of the ribs, upwards and downwards, is as direct, and with as little friction, as if it had been performed by ſtraight or perpendicular muſcles.

XIV. *An* Account *of the* Peat-Mosses *of Kincardine and Flanders in Perthshire. By the Reverend Mr* Christopher Tait, *Minister of Kincardine.*

[*Read July* 2. 1792.]

THE mosses of Kincardine and Flanders are situated in that extensive plain or *carse* which begins at Borrowstounness, on the south side of the Frith of Forth, and a little above Eastern Kincardine, on the north side. It stretches along both sides, first of the Frith, and afterwards of the river Forth, as far as Cardross, about twenty-two miles west of the point where it begins. The breadth of this plain, or carse, at Falkirk, where it is widest, is about seven miles, including what is occupied by the Frith. At Stirling it is contracted to three quarters of a mile, and the mean breadth of it, from that place to Cardross, is about three miles. The soil is a rich blue clay, beyond any depth that has been examined, excepting that a bed of gravel rises near to the surface for the space of a mile, betwixt Blair Drummond and Ochtertyre, and dips towards the Forth, at the rate of about one foot in the hundred. Almost the whole of this tract appears to the eye like a dead flat, the only eminences in it being those of Airth, Dunmore, Craigforth, and the hill of Dript, which are all inconsiderable, both as to extent and height. These eminences also contain the only rocks discovered

ed in the extent above mentioned, except that the Dript rock is continued acroſs the river, and that another rock alſo croſſes it, at what are called the cruives of Craigforth, and gives a conſiderable obſtruction to the ſtream, ſo as to prevent the tide from flowing up farther. Throughout the reſt of the carſe, no ſtones whatever are found in the ſoil; but beds of ſea-ſhells, particularly oyſter-ſhells, appear in many places of it, as in ditches, where the earth has been dug to a certain depth, and in the banks of the Forth and its branches. A bed of this kind, of conſiderable thickneſs, is to be ſeen near the bridge of Goody, a ſmall river that runs into the Forth; and another is to be ſeen in a bank, on the ſouth ſide of the road between Polmouth and Borrowſtounneſs. When the Forth encroaches upon its banks, it alſo diſcovers large logs of timber at various depths in the clay.

Concerning the river it may be neceſſary to remark, that the tide flows as far as the bed of rock near Craigforth, already mentioned, which is about 300 yards below the junction of the Teith and Forth. Above this point, the ſurface of the river is four feet and a half higher than the ſurface below, even at ſpring tides. The only other fall in the river from that place to Cardroſs, where the carſe terminates, is one of three feet at the ford of Frew, about eight miles diſtant from the former, in a ſtraight line.

It will ſerve to give ſome idea of the flatneſs of this country to obſerve, that by a ſurvey taken of the river, with a view to render it navigable, it was found, that a dam four feet in height, erected at the point of Craigforth, would increaſe the depth of the river more than three feet as far up as the ford of Frew; and that one of five feet in height, erected at Frew, would make a like addition to the depth of the river, as far as the ford of Cardroſs. The height therefore of the ſurface of the Forth, at the ford of Cardroſs, above the high water mark at the cruives of

Craigforth,

Craigforth, is lefs than ten feet, and this on a diftance of forty miles, meafuring by the courfe of the river, or of eighteen miles, meafuring in a ftraight line. The furface of the river is about twenty-one feet below the level of the clay-ground on each fide of it; yet in floods, the country is often overflowed to a confiderable extent.

A GREAT part of the furface of this country is covered by peat bogs, or moffes, as they are ufually called. The firft of thefe moffes and the furtheft eaft, is that of Kincardine, which lies in the angle between the Forth and the Teith, and reaches weftward as far as Burnbank, after which the carfe is clear of mofs through its whole breadth for the fpace of two miles and a half. Beyond this, Mofs-Flanders commences, and extends weftward all the way to Cardrofs, occupying a large portion of the carfe on both fides of the Forth. The mofs of Kincardine, when meafured twenty five years ago, contained above 1800 acres; but the operations which will be defcribed hereafter have now reduced it to about 1500.

BOTH thefe moffes are of the fame nature, as are alfo fome others lefs confiderable, which lie in this tract, to wit, the moffes of Frofk, Dunmore and Kinnaird, which occupy a large fhare of the carfe that lies at the head of the Frith, and alfo betwixt the rivers of Forth and Carron. The mofs of Frofk begins about five miles to the fouth-eaft of that of Kincardine, and the mofs of Kinnaird reaches within a mile and a half of the river Carron. The length of all thefe moffes, from the head of Mofs-Flanders near Cardrofs, to the fouth-eaft point of the mofs of Kinnaird, deducing the intervals that are clear of peat, is about fifteen miles, and the total of their contents is computed to exceed 9000 acres. The greateft height of the mofs above the clay on which it lies is fourteen feet and a half.

THE furface of the peat-mofs which thus rifes above the level of the carfe, when viewed at a little diftance, feems wholly covered

covered with heath, but when examined more clofely, is found to be made up only of fmall tufts of heath, intermixed with mofs-plants, fuch as ling, cotton-grafs, and in one fpot with wild rofemary; thefe tufts being feparated from each other by fpaces of bog, which are quite foft, and have no plant whatever on their furface.

When laid open, this mofs is found to confift of an accumulation of the *debris* of the fame plants, which are more or lefs advanced in putrefaction, according to the depth, and the degrees of humidity and compreffion. At the bottom of the mofs, or at the furface of the clay on which it refts, is a ftratum compofed chiefly of bits of rotten wood, but with which is mingled fometimes a little black earth, and fometimes alfo bunches of heath, far more entire than thofe which are found nearer to the furface of the mofs. Here alfo are innumerable trunks of trees, lying along clofe by their roots, which roots are ftill fixed in the clay, as in their natural ftate. The roots of the heath are alfo fixed in the clay, and appear to have been the production of the foil before the mofs was fuperinduced over it.

In the mofs of Kincardine, is a confiderable extent of what is called *flow-mofs*, that is, flowing or fluid mofs, the furface of which is fmooth, and which, until lately drained, was fo faturated with the water that was confined in it, either by the great extent of mofs upon all fides, or by the greater height of fome of the adjoining grounds, as to be almoft literally in the ftate which its name indicates. The other parts of the mofs have generally fuch a degree of folidity as fits them for being cut into peat, at leaft towards the bottom; for in the upper parts the plants are too little advanced in putrefaction, and too little compreffed, to have the cohefion requifite to be formed into peat.

The methods ufed for improving thefe moffes have been various. Sometimes, after the mofs was fo far drained by the common operation of making it into peat, as to bear cattle in dry

weather,

weather, it was repeatedly plowed and burnt, ſo as to be converted into a manure for the clay that was under it *.

This could only be done where the moſs was thin. Where it was too thick to be reclaimed in this manner, the people contented themſelves with improving the ſurface, by plowing the aſhes into it, or by laying upon it clay brought from the adjacent cultivated grounds. The progreſs, however, that was made in the cultivation of the moſs by theſe methods was never very conſiderable; and therefore, for ſome time paſt, they have given place to that of floating off the whole body of the moſs by water except a ſtratum two or three inches thick in contact with the clay. The ſoil thus cleared of moſs is excellent, and is found to let immediately for 15 s. *per* acre. This operation of floating is rendered practicable by the peculiar nature of this moſs, which, as has been ſaid, is ſuperinduced upon the original ſoil, ſo that the clay under it is on a level with the adjoining cultivated grounds.

This method of cultivation is ſuppoſed to have been practiſed on the moſſes betwixt the Forth and Carron about the beginning of the preſent century, where it is computed, that above 600 acres have been cleared with the water collected from the moſs.

* The people engaged in this work have their houſes in the moſs. Theſe are at firſt ſometimes built of ſod, ſupported by a frame of wood, laid on the ſurface of the moſs; but as ſoon as any progreſs is made in clearing the ground, they are cut out of the moſs itſelf. For that purpoſe, a drain is cut through the moſs, and at leaſt a foot deep into the clay, as far as the intended houſe is to reach; a ſpace from two to ſix yards wide is then cleared all round it; and laſtly the area of the houſe is alſo cleared, leaving a wall of moſs on every ſide, about four feet and a half thick, at bottom, and three feet thick at top. The feet of the cupples which are to ſupport the roof are inſerted into this wall, but do not reſt upon it, as they reach as low as the clay, from which they riſe up, nearly perpendicularly, as far as the top of the wall. The gables are completed with ſod or mud. As the moſs-walls dry, and are conſolidated, what was originally ten or twelve feet high, ſinks down to the height of five or ſix feet.

mofs alone, without the affiftance of any ftream from the higher grounds. The fame method feems to have been followed in the moffes of Kincardine and Flanders about forty years ago, though with little effect, and without any general plan, till about the year 1770, when the late Lord KAMES, who was proprietor of 1500 acres of the mofs of Kincardine, and a confiderable portion of mofs Flanders, adopted and greatly improved it. It is now in general ufe, and is conducted in the following manner.

A CHANNEL, about eighteen inches wide and two feet deep, is dug in the clay along the edge of the mofs intended to be removed, through which a ftream of water is conducted about a foot deep. The workman, with a wooden fpade, then cuts away a layer of the mofs along the edge of the channel to the breadth of about fix feet, and throws it into the water, which, if the channel has a tolerable declivity, will ferve to carry away as much mofs as fix men can throw into it. The mofs being thus removed for the whole length of the channel, to the depth of about thirteen inches, and to the diftance of about fix feet, the operation is repeated upon the mofs below, and fo on, till there is left a ftratum of mofs, only fix inches thick, upon the furface of the clay. This thin ftratum of mofs, being dried by the fummer heat, is afterwards dug, or plowed, and burned, and when the afhes thus produced are plowed into the clay, the ground is thought to be fufficiently prepared for a crop of oats.

AT the bottom of the mofs when thus cleared, a multitude of the bodies and roots of trees are found, which leave no doubt, that the grounds now covered by the mofs have been once occupied by a foreft. Though it is not, I believe, unufual to meet with trees in moffes, yet they are rarely found in fuch abundance as in the prefent inftance. For they are found here lying as thick upon the clay as they can be fuppofed to have grown upon it; and what is yet more fingular,

the roots remain fixed in the clay in their natural ſtate, correſponding, in ſize, and in ſpecies to the trees that lie by their ſides.

The trees are oak, birch, hazel, alder, willow, and in one place there are a few firs. Among theſe the oak abounds moſt, eſpecially upon the weſt ſide of the moſs, where forty large trees of this ſpecies were lately found lying by their roots, and as cloſe to one another as they can be ſuppoſed to have grown. One of theſe oaks meaſures fifty feet, in length, and more than three feet in diameter, and three hundred and fourteen circles, or year's growths, were counted in one of the roots. In another part of the moſs, an oak was found that meaſured four feet in diameter; and I am aſſured, that ſome years ago a root was diſcovered at Roſs, on the ſouth ſide of the moſs, that was fifteen feet in diameter at the ſurface of the clay; and the tree, which was twenty-two feet in length, was four feet eight inches in diameter at the lower end, where it had been cut over, at the height of a yard from the ground.

The oak is uſually black, and the wood ſtill ſound, eſpecially on the ſide of the tree that lies next the clay. It is fit for various purpoſes, and would probably be of much greater value, if the people into whoſe hands it falls had ſkill to dry it properly. As it is managed, it uſually opens into various fiſſures, which diſqualify it for being ſawn into planks.

The roots of the oak are all found fixed in the clay in their natural ſtate, and uſually riſe above it to the height of about three feet. They are very little rotten, and it requires much labour to grub them up.

The other kinds of trees are ſo much decayed, that fewer obſervations can be made upon them. Their roots are alſo fixed in the clay; but they generally riſe not more than a foot and a half above its ſurface.

The facts which have now been defcribed will perhaps be found, upon examination, to point out the caufe by which thefe trees were brought into their prefent fituation, and alfo the time when that event muft have taken place.

For, firft, thefe facts are utterly inconfiftent with the fuppofition that the trees have fallen through natural decay; as in that cafe, they muft have been broken over at different heights above the furface, and both the trunks and the roots muft have been too far advanced in putrefaction, before the mofs was formed over them, for any part of them to remain found at this day.

The fame circumftances feem alfo irreconcileable with the fuppofition, that thefe forefts have been blown down by the wind, as in that cafe alfo the trees muft have been broken over at different heights, and muft frequently have been torn up by the roots; a fingle inftance of either of which has not been feen by the author of thefe remarks. It is indeed faid, that a few fingle roots, in different parts of the mofs, have been obferved, which feem to be torn up, and what is perhaps difficult to be explained, no trunk was found attached to them.

It cannot be admitted as an argument in fupport of the preceding fuppofition, that the trees lie moft frequently in the direction from fouth-weft to north-eaft. For as the fouth-weft wind is the prevailing and moft violent wind in this country, the weight of the tops of the trees is generally turned from that quarter; and by whatever caufe they fall they will therefore, in general, be directed towards the north-eaft.

The moft plaufible folution therefore is, that the trees have been cut down. The height of the ftumps, which is commonly about two feet and a half, favours this opinion, as, at that height, the diameter of a large tree is ufually much lefs than it is nearer the ground, and as the cutter can better apply his

 ftrength

ſtrength at this than at a greater height. The ſoundneſs of the roots and trunks ſeems alſo inexplicable on any other ſuppoſition.

MARKS of an ax, not exceeding two inches and a half in breadth, are ſometimes diſcernible on the lower ends of theſe trees. The ſmall breadth of the ax, and the length of the time that the trees doubtleſs remained expoſed, before they were covered with the moſs, ſeems ſufficiently to account for theſe marks not having been more frequently diſcovered.

BUT it will be aſked, what reaſon can be aſſigned for undertaking a work of ſo great labour as the cutting down of ſuch extenſive foreſts muſt have been? The value of the timber was evidently not the motive of this work, otherwiſe the trees would not have been left behind. Neither was the clearing of the ground the object that was in view, ſince, after all this labour, the ground remained as much incumbered as before. If, however, we recollect the hiſtory of Britain from the reign of DOMITIAN to the acceſſion of CARACALLA, and conſider the local ſituation of the moſſes, we will find good reaſons for aſcribing the deſtruction of the foreſts in queſtion to the Romans.

IT is well known, that from the time when JULIUS CÆSAR firſt invaded this iſland to the decline of the Roman power, the Britons, unable to contend with the arms and diſcipline of the legions in pitched battles, or in the open country, were forced to take ſhelter in their woods and moraſſes, from which they annoyed the Romans by their incurſions. The Roman Generals, therefore, from the time of AGRICOLA at leaſt, employed not only their own ſoldiers, but alſo many of the provinciated Britons, in depriving the free Britons of their places of refuge, by cutting down the woods, or, at leaſt, making great openings in them, and by draining the moraſſes, or making roads through them. Theſe ſeem to be the ſervile labours which GALGACUS,

in

in his ſpeech before the battle with AGRICOLA, warns the Caledonians of, as awaiting the vanquiſhed. *Corpora ipſa ac manus, ſylvis ac paludibus emuniendis, inter verbera ac contumelias conterunt* *.

IN like manner, SEVERUS is ſaid to have employed a great part of his troops, not only in building the wall which bears his name, but in cutting down the woods, draining the marſhes, and throwing bridges over the rivers which obſtructed his march into the northern parts of Britain †. But though in that march he muſt probably have paſſed over the very grounds now occupied by the moſſes of Kincardine and Froſk, I am inclined to believe, that the deſtruction of the foreſts upon the ſide of the Forth, is rather to be attributed to his predeceſſors, who aimed at making the wall between the Friths of Forth and Clyde, the limits of their empire, than to SEVERUS himſelf, who withdrew his troops from the country betwixt the two walls, and either ſtrengthened ADRIAN's wall, from the Tyne to the Solway Frith, or built another nearly in the ſame direction.

THE Romans indeed muſt have found themſelves more incommoded by the foreſts in queſtion than by any other almoſt in the iſland; both becauſe of their vicinity to the Roman province, and becauſe the only roads by which the Romans could penetrate into the country poſſeſſed by the Caledonians were through the carſe, and acroſs the grounds between the moſſes of Froſk and Kincardine.

THE moſs of Kinnaird, which was no doubt formerly united to that of Froſk, is only a mile and a half diſtant from the

* TACITUS in Vit. AGRIC. cap. 31.

† Σεβῆρος δἰϊὼν την Καληδονίαν, ἀμύθητα πράγματα ἐσχε, τας τε ὕλας τεμὼν, τα τε ἕλη χωννυὼν, και τους ποταμους ζευγνύων. DIO. CASS. *Lib.* lxxvi. *cap.* 13. The works here enumerated were attended with ſuch difficulty, that though, according to the ſame hiſtorian, SEVERUS was never met by the Britiſh army in the field, he loſt fifty thouſand men in the courſe of this expedition. *Ibid.*

the river of Carron, which river, where it enters the carſe, and ceaſes to be fordable, ſeems to have been the boundary of the Roman province *, and the moſs of Kincardine is only twelve miles diſtant from the ſtation at Camelon. Foreſts, therefore, in either of theſe places would have afforded very convenient refuge to the Caledonians, whether they were making incurſions into the Roman province, or haraſſing the Roman armies in their expeditions towards the north.

Besides, that a people, more civilized than the ancient Caledonians, muſt have been in this country before the moſs of Kincardine exiſted, is completely eſtabliſhed by the diſcovery of a road on the ſurface of the clay at the bottom of that moſs, after the peat, to the depth of eight feet, had been removed. The part of this road already diſcovered is about ſeventy yards long; the breadth of it is four yards, and it is conſtructed of trees, meaſuring from nine to twelve inches in diameter, laid in the direction of the road. Acroſs theſe have been laid other trees about half their ſize, and the whole has been covered with bruſhwood. The depth of the materials varies in conformity to the nature of the ſoil; the trees, which are laid lengthwiſe, being generally on the ſurface of the clay, but in the loweſt and wetteſt parts, they are ſunk about two feet under the ſurface.

This road lies acroſs a piece of ground lower than the adjacent grounds, and its direction is from the Forth acroſs the moſs, where it is narroweſt, towards a road, ſuppoſed to be Roman,

* That the river Carron was the boundary of the Roman province is rendered probable by the ſituation of Arthur's Oven, as it was called, which is ſuppoſed to have been a temple dedicated to Terminus, and erected near the Roman frontier. It ſtood on the weſt ſide of the river Carron, or between that river and Kinnaird. There is alſo a paſſage in Herodian that favours the ſame opinion. That hiſtorian mentions the army of Severus paſſing τα προβεβλημενα ῥεύματά τε και χώματα της Ρωμαιων αρχης. He adds, that on this frontier the Barbarians eaſily made their eſcape, *and concealed themſelves in the thickets and marſhes.* Herod. *Lib.* iii. *cap.* 48.

man, that paſſes between the moſs and the river Teith. The veſtiges of this laſt road have been traced, from about four miles north-weſt of the bridge of Dript, where formerly there was a ford, acroſs the river, ſouth-eaſt by Torwood and Larbert, to Camelon on the wall. This road is laid about a foot deep with gravel, under which, in ſome places, is alſo a layer of ſtones, and it appears to have been about twenty feet wide, though, by the land having been under tillage, its breadth cannot be exactly aſcertained. The direction of it, after it croſſes the Forth at Dript, is in a line that points north-weſt to the paſs of Leny, the chief avenue to the Highlands on this ſide, and through which the military road to Fort William is now actually conducted. It is therefore conſidered, with great probability, as having been originally deſigned for the uſe of the troops employed to repel the incurſions made by the Caledonians, from the mountains, into the Roman province. At the ſame time, it may have been connected with the other roads that ſtretched more directly toward the north, by Dumblane and the well known ſtation of Ardoch. It can ſcarcely be doubted, that it alſo communicated with the road in the moſs, and that this laſt is to be reckoned a part of the military works of the Romans.

On the whole, therefore, the concluſions to which we are thus neceſſarily led appear to be theſe: That before the time of Agricola, the firſt of the Roman Generals who attempted to ſecure the northern frontier of the province by a regular chain of poſts *, the greater part of the level country on the banks of the Forth was occupied by extenſive foreſts: That about this period, or ſoon afterwards, a great part of thoſe foreſts,

* The chain of poſts between the Forth and Clyde is mentioned by Tacitus, *Vit.* Agric. *cap.* 23. as the work of Agricola's fourth campaign, which coincides with the year 81 of our æra. See Horseley's *Britan. Book* i. *chap.* 3. It was about fifty years afterwards that the wall of Antoninus was built, nearly in the ſame line. The age of the moſs cannot therefore be eſtimated at much leſs than 1700 years.

refts, being at no great diftance from the above frontier, were cut down by the Romans for the purpofe of depriving the natives of the faftneffes and places of ftrength from which they were continually making incurfions into the province; and that from the trees thus cut down, and fuffered to rot upon thofe low and marfhy grounds, originated the vaft body of peat-mofs which covers them at the prefent time. The production of peat-mofs from the decay of forefts, is not a *poftulatum* that will be fuppofed fubject to any difficulty. It is a principle admitted by naturalifts, on the ground of actual obfervation*, with refpect at leaft to countries in high latitudes, and ferves to explain many appearances in other parts of this ifland, which have a great refemblance to thofe that have now been defcribed †.

* See Lord CROMARTY's paper on Peat-mofs, Phil. Tranf. vol. xxvii. p. 296.

† See an Account of Hatfield Chace near Doncafter, Phil. Tranf. vol. xxii. p. 980. It may be proper to obferve, that the moffes of Kincardine, &c. being placed above the level of the adjacent plain, are of the kind that might be expected to break out and overfpread the lower grounds, which however they are not known to have done, while they remained in their natural ftate. They do not indeed abound very much in water, infomuch that the floating off of the peat, when it is carried to fuch an extent as it is now, requires an artificial fupply of water. This fupply is accordingly procured at prefent by an engine which Mr DRUMMOND has caufed to be erected for raifing water from the Teith, and which is one of the moft material improvements that has been made in the hufbandry of the mofs.

BUT though there is no memory of the mofs having flowed while it remained in its natural ftate, on the 21ft March 1792, it burft out on the weft fide, near the fouthermoft cottage, to the height of its fide-wall, covering fifty-fix yards in breadth, and about the extent of an acre of ground that had been cleared, and early in the morning of the fame day of 1793, (fince the firft communication of this paper), it was difcovered to have flowed again, and to have reached the northermoft cottage of the fame line of houfes. The inhabitants efcaped by a window on the oppofite fide of the houfe. The mofs afterwards bore down the fide-walls of the houfe that were built of ftone, and continued to flow flowly forward, eight

eight feet in depth at the middle, and 1200 feet in breadth, until nine o'clock in the morning of the 23d, when it had advanced 600 feet, and covered twelve acres of ground that had been cleared. It would undoubtedly have flowed much farther, had not a great number of men been employed night and day, in giving vent to the water mixed with the moſs that had flowed, and in intercepting that which continued to diſcharge itſelf from the main body of moſs.

END OF PAPERS OF THE PHYSICAL CLASS.

II.

PAPERS OF THE LITERARY CLASS.

I. TABLEAU *de la* PLAINE *de* TROYE : *Accompagné d'une* CARTE, *levée géométriquement, en* 1785 *et* 1786. *Par M.* CHEVALIER, *des Académies de* MÈTZ, *de* CASSEL, *de* ROME, *et de la Société Royale d'* EDINBOURG.

[*Read by the Author, Feb.* 21. 28. *and March* 21. 1791.]

CHAPITRE I.

Voyage de Venise au Cap Baba, sur la côte d'Asie.

A LA suite du voyage d'Italie, j'attendois à Venise une occasion favorable pour entreprendre celui de la Grèce. Le Chevalier ZULIANI, nommé Ambassadeur de la République auprès de la Porte Ottomane, alloit incessamment partir pour sa destination ; je lui demandai une place sur son vaisseau, et je fus assez heureux pour l'obtenir. Cet Ambassadeur, qui réunit à toutes les qualités d'un habile negociateur, le gout le plus décidé pour les arts et pour les sciences, avoit aussi reçu dans son vaisseau le célèbre Docteur SPALLANZANI, l'un des plus ingénieux naturalistes de ce siècle, que l'Empereur JOSEPH II. envoyoit

dans le Levant, pour enrichir la ſcience de la nature de découvertes nouvelles.

Je ne tardai pas à appercevoir dans mes reſpectables compagnons de voyage, parmi les brillantes qualités qui les diſtinguent, la même paſſion que j'avois moi-même pour les monumens de l'antiquité ; bientôt nous nous fumes entendus, et partout où le vaiſſeau relachoit, il ſembloit qu'un inſtinct commun rapprochât nos penſées et dictât nos projets.

Après avoir parcouru enſemble les côtes et les îles du Golphe Adriatique ; après avoir viſité les antiquités de Pola, les montagnes de la Chimère, les îles d'Ithaque, de Corfou, de Céphalonie, de Zanthe, et de Cythère, nous abordâmes, après une affreuſe tempête, au promontoire de *Sunium*, où l'on voit encore les impoſans débris d'un temple de *Minerve Suniade* *. Je débarquai là, et par un de ces accidents qui n'arrivent que trop ſouvent aux voyageurs, que l'excès de leur curioſité emporte loin du port, lorſque des vents impérieux forcent le vaiſſeau de mettre à la voile, je fus réduit à la douce neceſſité de voir Athènes et une partie du continent de la Grèce.

En quittant l'Attique, je m'embarquois au port Pirée dans l'intention d'aller directement à l'embouchure de l'Helleſpont, pour y chercher la *Plaine de Troye*, que j'avois fixée, même avant mon départ de l'Italie, comme le principal objet de mes recherches ; mais les vents contraires, (je devrois plutôt les appeller favorables) me jetterent ſucceſſivement dans les plus belles îles de l'Archipel, et enfin dans celle de Mitylène, d'où j'atteignis le *Cap Baba*, que les anciens appelloient *Lectos*.

Me trouvant ſur la côte d'Aſie, dans un point très éloigné de l'Helleſpont, je réſolus de la ſuivre avec l'attention la plus ſcrupuleuſe, et d'obſerver ſurtout les plaines et les fleuves qui ſe rencontreroient ſur ma route ; c'étoit le moyen le plus sûr de découvrir la ſituation de la plaine de Troye, et les momunens mentionnés

* Voiez Les Ruines des plus beaux monuments de la Grèce, par M. le Roy : et Chandler's Travels in Aſia Minor, p. 9.

mentionnés dans les poëmes d'HOMÈRE. Les differentes épreuves que j'avois faites de son exactitude dans les lieux que je venois de parcourir, m'autorisoient à penser qu'il n'en auroit pas manqué dans la description de la Troade ; et j'étois d'avance convaincu que je devois la trouver telle qu'il l'a dépeinte dans ses vers.

IL ne me sera pas difficile, me disois-je à moi-même, de trouver ces deux promontoires qui terminoient le camp des Grècs, et où étoient les postes d'AJAX et d'ACHILLE *. Parmi les vallées voisines de la plaine de Troye, je démêlerai celle de Thymbra, où les alliés des Troyens étoient campés †. Je distinguerai le cours impétueux du violent *Simoïs* ‡, et les eaux limpides du divin *Scamandre* ‖, dont les bords sont couverts de fleurs. Elles ne doivent pas être perdues les sources de ce divin fleuve que le Poëte a designées par des caracteres aussi particuliers et aussi saillans §. Pourquoi ne resteroit-il pas quelques traces des tombeaux de ces guerriers fameux, qui devoient être l'objet du culte des navigateurs dans la posterité la plus reculée ? ** Ces agréables collines qui s'étendoient le long des bords du Simoïs n'auront pas perdu, sans doute, leur position ni leurs charmes ††. Peutêtre même pourrai-je retrouver encore l'emplacement de l'ancienne Troye, le tombeau du vieux ÆSYETES ‡‡, celui d'ILUS ‖‖, et cette *colline des figuiers* qui donnoit tant d'inquiétudes à ANDROMAQUE §§.

VOUS aurez peine à croire, Messieurs, que ce beau songe se soit réalisé ; et je craindrois, avec raison, de passer à vos yeux pour un enthousiaste et un visionnaire, si la plûpart des monumens que je viens de citer, n'avoient pas été aumoins remarqués, si non exactement observés, par des voyageurs dont vous respectez les noms ; et s'ils n'étoient pas encore exposés à la vue de ceux qui prendront dans la suite la peine de vérifier leur position au moyen de la carte topographique que j'ai dressée.

ENIVRÉ

* Iliad. viii. 222. xi. 5.
† Ib. x. 430.
‡ Ib. xii. 21, 22. xxi. 307.
‖ Ib. vii. 329. xii. 21. ii. 467. v. 36.
§ Ib. xxii. 147.
** Iliad. vii. 86. xxiii. 45. 255. Od. xxiv. 80.
†† Iliad. xx. 53. 150.
‡‡ Ib. ii. 793.
‖‖ Ib. x. 415. xi. 166. 371. xxiv. 349.
§§ Ib. vi. 433. xi. 167. xxii. 145.

Enivré donc d'avance d'une foule de jouiſſances futures, alors très incertaines, je pàrs du Cap Lectos accompagné d'un Janiſſaire, qui ne manqua pas de chercher à m'effrayer par des dangers imaginaires, afin d'être plus largement récompenſé pour les avoir courus avec moi, et avoir montré la réſolution de m'en garantir.

Après avoir obſervé ſur ma route les débris d'un temple, et les ſalines de Tragéſée, dont l'abondance, ſuivant Strabon *, dependoit autrefois de certains vents périodiques, ou étéſiens, qui y apportoient le ſel tout formé, j'arrive ſur les ruines d'*Alexandria Troas*, que les Turcs appellent *Eſki-Stamboul, la vieille Conſtantinople*, comme s'ils la croyoient digne par ſes reſtes immenſes d'avoir été l'ancienne capitale de leur Empire.

CHAP. II.

Deſcription d'Aléxandria Troas et de ſes Ruines.

" Aléxandre le Grand, dit le Dr Chandler, au lieu de " marquer ſes progrès par des ravages et des véxations, " comme le commun des conquérants, laiſſoit ſagement des mo- " numens durables de ſes victoires dans tous les lieux qu'il ſub- " juguoit. Il batiſſoit des villes ; il élevoit des temples ; et com- " me le ſéjour qu'il faiſoit dans chaque ville n'étoit pas de " longue durée, il laiſſoit à des miniſtres éclairés, et dignes de " ſa confiance, le ſoin d'éxécuter ſes vaſtes deſſeins.

" *Alexandria Troas* fut une des dix huit villes qui por- " toient ſon nom ; elle fut commencé par Antigonus, et prit " d'abord le nom d'*Antigonia ;* mais Lysimaque, à qui elle " échut en partage comme patrimoine d'Aléxandre, lui donna " le nom de ce conquérant.

" Dans la guerre d'Antiochus elle ſe diſtingua par ſa fi- " délité pour les Romains, qui, en récompenſe, lui accorderent

" tous

* Lib. xiii. p. 902. edit. Amſt. 1707.

" tous les privileges dont jouiſſoient les villes d'Italie. Au-
" guste y envoya une colonie qui en augmenta la population,
" et elle devint la plus conſidérable de toutes les villes qui ſe
" trouvoient entre le Cap Sigée et le Cap Lectos *."

Suétone raconte que Cesar, par reſpect pour la contrée qui donna naiſſance à ſes ayeux, avoit formé le projet d'y tranſporter les richeſſes de l'Empire †. On croit qu' Auguste en avoit été tenté lui même, mais que Mécène, Agrippa, et les principaux courtiſans de ce prince, connoiſſant l'influence de la poëſie ſur ſon cœur, engagerent Horace à lui addreſſer cette ode dans laquelle il introduit avec un art et une delicateſſe admirables, la Déeſſe Junon menaçant les Romains de toute ſa colère s'ils entreprenoient de relever les murailles de Troye :

Sed bellicoſis fata Quiritibus
Hac lege dico, ne nimium pii,
Rebuſque fidentes, avitæ
Tecta velint reparare Trojæ ‡.

Il eſt poſſible que Cesar ait eu des raiſons de ſe dégouter de ſéjour de Rome, et qu'il lui ſoit venu dans la penſée de s'en éloigner ; mais on ne peut guères ſuppoſer qu'Auguste, adoré de ſes ſujets, ait put nourrir un inſtant dans ſon ame le projet de s'éloigner d'eux, et qu'après avoir pacifié l'univers, il ait préferé l'obſcure ville d'Alexandrie, au brillant ſéjour de Rome.

Le premier objet qu'on apperçoit en arrivant à Eſki-Stamboul du Cap Baba, ſont les bains chauds, que les Turcs apellent *Lidja-Hamam.* Ils ſont entretenus par deux ſources dont la chaleur eſt differente, quoiqu'elles ne ſoient pas à trente pas l'une de l'autre. Le thermometre de Fahrenheit, qui étoit à l'ombre à 82 degrés, eſt monté dans l'une à 113, et à 110 dans l'autre.

Une

* Travels in Aſia Minor, chap. ix. Strabo, lib. xiii. p. 887. edit. Amſt. 1707.

† Sueton. c. 79.

‡ Lib. iii. Od. 3.

Une tradition conſervée parmi les Turcs qui habitent les villages voiſins, nous apprend, que dans le ſiècle dernier ces ſources tarirent à la ſuite d'un tremblement de terre, et qu'elles ne reparurent que dix ans après. Les murailles qui les entourent ſont remplis de débris de ſtatues ; parmi leſquelles j'ai reconnu celle de Hercule jeune, et d'une femme dont la draperie m'a paru du plus beau ſtile.

La colline ſur le penchant de laquelle ſont ſitués les bains de *Lidja*, eſt couverte de tombeaux. En la parcourant juſqu'au bord de la mer, on trouve à chaque pas des Turcs occupés à briſer des Sarcophages de marbre blanc, ornés de bas-reliefs et d'inſcriptions, pour en faire des boulets, ou des décorations à leur propres ſépultures. Depuis long tems les ruines d'*Alexandria Troas* fourniſſent de boulets les chateaux des Dardanelles, et la ſource eſt loin d'être epuiſée.

Celui de tous les monumens ſitués au dehors de la ville, que la main du tems ſemble avoir le plus reſpecté, a la forme d'une colonne briſée, de dix pieds de diamètre ; il ſe trouve près des ruines d'un aqueduc, qui s'étend encore fort loin vers l'embouchure de l'Helleſpont, et qui par ſa magnificence, et ſa ſolidité, rappelle le généreux patriotiſme de celui qui l'a bati.

Herodes Atticus, gouverneur des villes libres d'Aſie, voyant celle d'Alexandrie condamnée à s'abbreuver de l'eau corrompue des citernes et des puits, écrivit à Adrien pour le ſupplier de ne pas permettre q'une ville maritime auſſi intéreſſante fut privée d'un ſecours que de ſimples villages de l'Aſie avoient obtenu de lui.

Adrien lui accorda ſa demande, et le créa Intendant des ouvrages qu'il falloit conſtruire pour apporter des eaux dans cette ville. La dépenſe excéda ſept millions de drachmes. Les ennemis de Herodes s'en plaignirent à l'Empereur, et lui repréſenterent, que le tribut de cinq cents villes avoit été ſacrifié pour ce ſeul ouvrage. Herodes convint que la dépenſe avoit en effet excédé ſa premiere eſtimation, mais il déconcerta ſes calomniatures

lomniateurs, en prouvant qu'il avoit fourni l'excédant de fes propres fonds.

Cet aqueduc, dont les ruines s'étendent à plus d'un mille vers le nord, ou vers l'Hellefpont, n'eft pas le feul monument que ce grand homme ait élevé dans le cours de fa vie ; il batit entr'autres le ftade d'Athènes, qui fubfifte encore aujourd'hui, et dont la magnificence eft tant vantée par Pausanias.

Les murailles d'Alexandrie font prefqu' entièrement confervées ; elles ont huit pieds d'épaiffeur, font conftruites en pierre de taille, et flanquées de tours. La colline qu'elles renferment, et fur laquelle la ville étoit fituée d'une manière très avantageufe, eft féparée à l'eft de la chaine de l'Ida, par le vallon où coulent les eaux thermales, et s'étend en s'abaiffant vers la mer. dans l'efpace d'environ une demie lieue quarrée.

Les fondateurs de cette ville, ne durent point être infenfibles aux avantages qu'elle pouvoit tirer de fa fituation à l'embouchure de l'Hellefpont, et du voifinage de ces eaux thermales, célèbres encore aujourd'hui, par leur efficacité contre la lépre, les rhumatifmes, et les maladies de peau : Il paroit que fes habitans n'ignorerent pas non plus le prix du commerce, et l'utilité d'un port. La Nature avoit ébauché l'enceinte de celui, dont on admire aujourd'hui les ruines. Je ne fais fi les énormes colonnes de granite qui font jettées çà et là dans fon vafte baffin, fervoient autrefois à le décorer, ou fi les Turcs, après les avoir roulées du haut de la ville, ont renoncé à les embarquer à caufe de leur pefanteur.

Les édifices publiques font toujours ceux qui refiftent le mieux aux injures du tems. On reconnoit encore parmi les ruines d'Alexandrie, un ftade, un théâtre, deux temples, et une immenfe fabrique, que les navigateurs apperçoivent à la mer très loin, à travers les touffes de Valoniers qui couvrent maintenant l'efpace qu' occupoit la ville.

Pococke et Chandler regardent cet édifice comme un gymnafe, où la jeuneffe étoit inftruite dans les fciences, et des

exercices du corps *. Le commun des navigateurs lui donne le nom de *Palais de* Priam, ſans ſonger que ce palais devoit être fort éloigné de la mer, et que celui-ci eſt preſque ſur ſes bords.

Quant à moi, j'ai été frappé à la première vue de la reſſemblance de cet édifice avec les thermes de Diocletien et de Caracalla, qu'on voit à Rome ; mais ce qui m'a entièrement convaincu qu'il étoit deſtiné à l'uſage des bains, c'eſt ce grand édifice ſemicirculaire qui ſe trouve à l'angle meridional du monument, et dans lequel aboutiſſent les canaux de l'aqueduc qui y apportoient les eaux. Si Pococke et Chandler, avoient vus ces canaux,—s'ils avoient pénétrés dans leurs voûtes encore enduites de ſédiments aqueux,—s'ils avoient obſervé la direction de l'aqueduc qui s'y termine, ils n'auroient certainement pas méconnu ſa deſtination.

La vallée compriſe dans l'enceinte des murailles, et qui les Turcs appellent *Beian-Deré*, eſt en partie artificielle ; elle eſt traverſée dans toute ſa longueur par un grand égout, où venoient ſans doute aboutir toutes les eaux de la ville, et dont l'embouchure pour la grandeur et la conſtruction, ne le céde en rien au grand égout bati à Rome par les Tarquins.

CHAP. III.

Voyage d'Alexandria Troas au Chateau d'Aſie nommé Koum-Kalé.

Après avoir ſcrupuleuſement examiné, meſuré, et deſſiné tous les monumens d'Alexandria Troas ; après avoir fixé géométriquement leur poſition, tant entr'eux que relativement à

* A deſcription of the Eaſt, vol. ii. part. ii. p. 109. Travels in Aſia Minor, p. 27.

à l'île de Tenedos, qui eſt en face, je continuai ma route, en cotoyant toujours la mer Egée.

Je trouve d'abord une vaſte plaine, que j'aurois été tenté de prendre pour celle de Troye, ſi j'y avoit reconnu la trace de quelque fleuve. Je laiſſe enſuite à ma droite les villages de *Dabri*, de *Gheiſlik*, et de *Bos*, et j'arrive enfin, à travers une longue chaine de baſſes collines ſans culture, au pied d'une éminence conique, évidemment artificielle, que j'avois apperçue à l'horizon dès le moment où j'avois quitté les murs d'Alexandrie. Cet objet remarquable attira toute mon attention par ſa forme réguliere, par ſa maſſe énorme, par ſa hauteur, qui n'eſt pas au deſſous de cent pieds, et par ſon contour, que je trouvai de quatre cent pas.

J'étois très empreſſé de ſavoir, ſi les Turcs qui habitent les villages voiſins avoient coutume de déſigner cette petite montagne par quelque nom particulier. Ma curioſité fut pleinement ſatisfaite, lorque j'appris qu'ils la regardoient comme un tombeau des infidels, et qu'ils lui donnoient le nom très extraordinaire de *Tapé* ou *Tepé*, accompagné du nom du village le plus voiſin, qui eſt *Udjek*.

En obſervant la forme de ce monument, et la parfaite reſſemblance du nom Tapé, que les Turcs lui donnent, avec celui que les Egyptiens donnoient à leur tombeaux, je ne pouvois guères me refuſer à croire, que celui-ci en étoit un lui-même, ou dumoins une de ces montagnes ſacrées ſur leſquelles les peuples d'Aſie avoient coutume d'offrir des ſacrifices: Mais comme je n'avois encore aucune idée de la plaine de Troye, qui cependant ſe trouvoit alors bien près de moi, je ne pouvois que former des conjectures, mais point aſſeoir d'opinion ſur la nature de ce monument. Ce ne fut que dans la ſuite, je pourrois dire même après le troiſième voyage fait dans la Troade, que je pu prononcer un jugement raiſonné ſur ce monticule, et ſur tous ceux de la même eſpèce qui ſe trouvent dans la plaine de Troye; je me contentai pour lors d'en meſurer la hauteur et le contour,

 et

et de détailler de ſon ſommet l'un des plus beaux points de vue qu'il y ait au monde. Au midi j'appercevois les ruines d'Alexandrie, à plus de quatre lieues de diſtance ; à mes pieds, du côté du nord, une immenſe plaine entourée de charmantes collines ; à l'eſt, les pics de l'Ida ; et à l'oueſt, la mer Egée, les îles de Tenedos, d'Imbros, de Samothrace, de Lemnos, et juſqu'au ſommet du mont Athos.

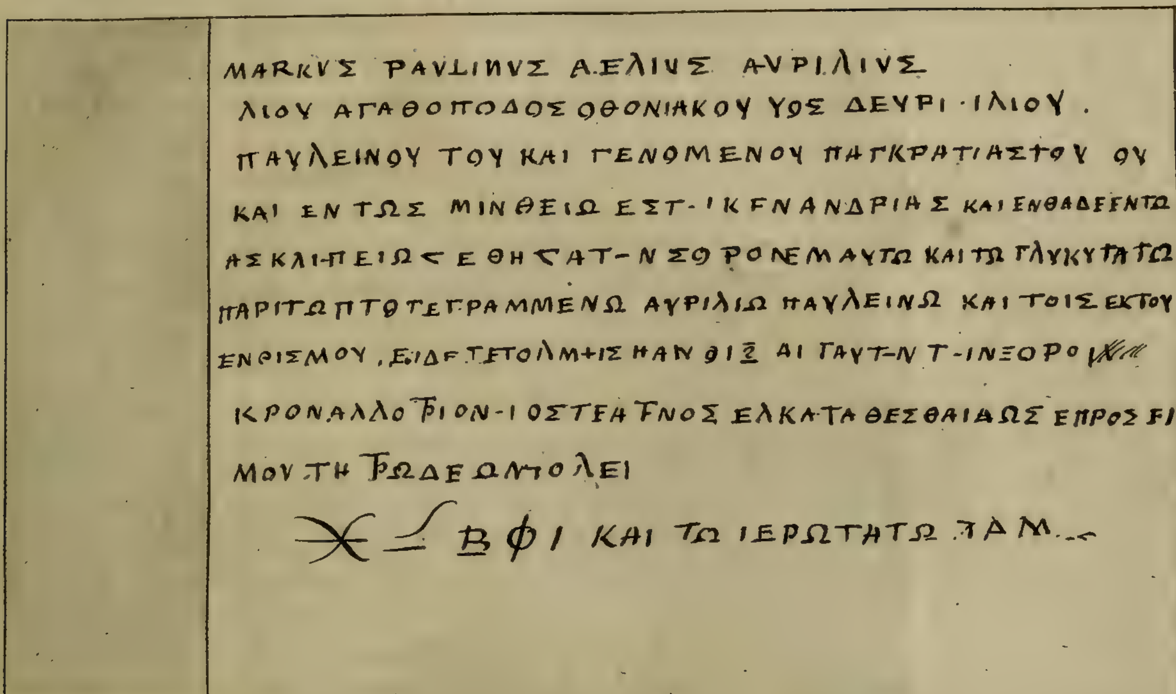
A UN mille environ de ce monument, on trouve le village d'*Erkeſſighi;* près duquel lorſque j'y paſſa, le fameux HASSAN, dernier Capitan Pacha, faiſoit batir un joli *Kioſk* ou *Tchiftlik*, pour pouvoir s'y repoſer lorſque la flotte Turque, au retour de ſa croiſière dans l'Archipel, ou de quelqu'autre expédition, attend les vents de ſud, à l'embouchure de l'Helleſpont.

QUELQUES jours avant mon arrivée, ſes architects avoient fait tranſporter d'Alexandrie un magnifique Sarcophage de marbre blanc, pour en faire l'auge d'une fontaine. Je fut encore plus choqué du vil uſage auquel on deſtinoit ce monument précieux, lorſque j'apperçus ſur une de ſes faces les reſtes d'une inſcription Grèque, dont j'avois trouvé le commencement à Alexandrie, parmi les morceaux que ces barbares avoient détaché du Sarcophage pour le façonner à leur bizarre fantaiſie.

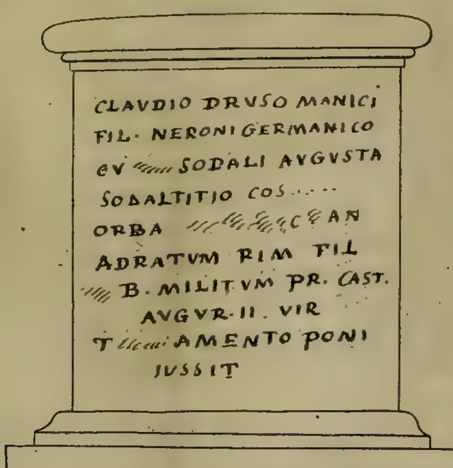
AU deſſous du Kioſk dont je viens de parler, on voit un ruiſſeau conſidérable, dont les eaux parfaitement limpides, après avoir ſuivie la chaine des collines qui s'étendent vers le ſommet de la grande plaine, ſemblent avoir été detournées de leurs cours naturel, pour ſuivre un nouveau canal qui les porte dans la plaine voiſine. Il n'eſt pas difficile d'appercevoir, que c'eſt la main des hommes qui a changé le cours de ce ruiſſeau. Son lit, généralement très peu profond, en formant de nombreuſes ſinuoſités, avant de parvenir au deſſous du Kioſk, acquierre là, tout d'un coup, une grande profondeur, il ſuit une ligne rigoureuſement droite ; et l'on voit ſur ſes bords un talus très élevé, formé par les terres qu'on en a retirées pour le creuſer.

VOUS

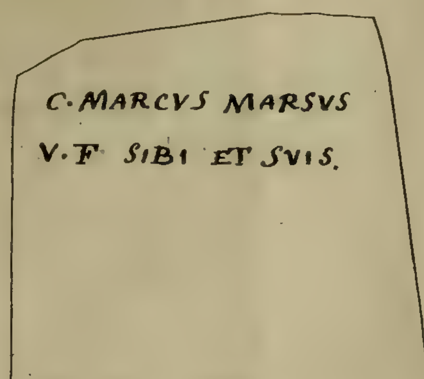
N.° 1. Inscription trouvée sur un Sarcophage au village d'Erkessighi.



N.° 2. Inscription trouvée sur une pierre sepulcrale au village de Kemalli. Voyez p. 26.



N.° 3. Inscription trouvée prés la fameuse inscription Sigeéne. Voyez p. 14.



Vous n'etes pas ſurpris, Meſſieurs, de me voir m'appeſantir ſur la deſcription d'un ſimple ruiſſeau ; tout devient intéreſſant quand on croit approcher de la plaine de Troye :

Nullum eſt ſine nomine ſaxum *.

Ce ſeroit un crime d'y négliger quelque choſe ; il ne faut pas imiter Cesar, qui paſſa ſur le Scamandre ſans le reconnoître.

Inſcius in ſicco ſerpentem gramine rivum
Tranſierat, qui Xanthus erat †.

Je ſuis donc le cours de ce joli ruiſſeau juſqu' à ſon embouchure dans la mer Egée. Là j'apperçois un marais couvert de roſeaux trés épais et très elévés ; et, à peu de diſtance, un moulin, qui pourroit bien être la véritable cauſe pour laquelle on a detourné le ruiſſeau de ſon ancien cours. Cette conjecture eſt d'autant plus fondée, que tous les villages d'alentour ſont réduits à la reſſource des moulins à vent,—reſſource très précaire dans un pays auſſi tempéré que cette partie de l'Aſie. Il ne ſeroit pas ſurprenant que le cours de ce ruiſſeau, n'eſt été detourné par Herodes Atticus lui-même, et que l'aqueduc dont les ruines s'étendent vers la plaine de Troye, n'eut été deſtiné à porter ces eaux à Alexandria Troas.

De l'embouchure du ruiſſeau je dirige ma route vers le village de *Jeni-chehr*, en cotoyant le rivage de la mer, qui dans tout cet eſpace eſt compoſé de rochers taillés à pic, d'une hauteur effrayante : J'étois curieux de m'approcher de ce rivage, pour y obſerver de plus près differens monticules que j'avois apperçus du ſommet du monument d'Udjek, et qui me paroiſſoient avoir la même forme que lui.

La première de ces éminences que je trouvai ſur ma route, eſt appellée par les Turcs *Beebik-Tapé*, et n'eſt pas a beaucoup

près

* Lucan. Pharſ. lib. ix. 973. † Ibidem.

près auſſi élevée que celle d'Udjek. Près d'elle on voit une tranchée artificielle, pratiquée dans l'épaiſſeur de la montagne, dont il n'eſt pas aiſé de déſigner le motif ni l'uſage. Un peu plus loin je trouvai la ſecond éminence, qui me parut de la même dimenſion que la précédente ; et comme elle, très bien expoſée à la vue de navigateurs qui entrent dans l'Helleſpont. Je n'ai point pu découvrir quel nom les Turcs donnoient à celle-ci, mais je ſuppoſe qu'elle prend, comme beaucoup d'autres, le nom du village qui l'avoiſine.

Le village de *Jeni-chehr*, peuplé de Grecs, et ſitué ſur la pointe d'une promontoire élevé, qui avec celui de la Cherſoneſe de Thrace forme l'entrée du canal de l'Helleſpont. Au moment où j'allois entrer dans l'égliſe, j'apperçois ſur un bloc de marbre ces deux mots à peine liſibles, ΦΑΝΟΔΙΚΟ ΕΙΜΙ—— c'eſt le commencement de la fameuſe inſcription Sigéenne, connue de tous les érudits, et dont Chishull * a donné une deſcription particulière.

En face de l'inſcription, à gauche de la porte de la même égliſe, on voit auſſi un bas relief, en marbre, de la plus belle exécution. Il repreſente une femme aſſiſe ; des nourrices tenant des enfans emmaillottés dans leurs bras, ſemblent les preſenter à la figure aſſiſe. Un autre perſonnage vient à la ſuite des nourrices, et porte un petit coffre de la main droite, et une eſpèce de coquille de la gauche.

Le Dr Chandler a parfaitement expliqué ce bas relief : " On ſait," dit il, " que les Grecs avoient coutume de mettre " leurs enfans ſous la protection de quelque divinité, et que les " nourrices alloient les lui préſenter le cinquième jour après " leur naiſſance. Les Romains avoient auſſi la même ſuperſti- " tion ; et Caligula ſe ſouvient d'avoir placé ſa fille Livia " Drusilla dans le giron de Minerve. Il eſt bien naturel de " croire que le bas relief ci deſſus repreſente cette cérémonie " des nourrices ; que la figure aſſiſſe eſt la Déeſſe Minerve, et " que

* Voyez Antiq. Aſiaticæ ; auſſi Inſcriptiones Antiquæ ; par Chandler.

" que le petit coffre porté par la dernière figure, renferme l'en-
" cens, et les offrandes destinées à la Déesse *."

Vous concevez aisément, Messieurs, l'extrême désir que j'eus d'enlever ces deux interéssans monumens, et vous me pardonnerez même peutêtre les tentatives que je fis, et les dangers auxquels je m'exposai, pour les arracher à leur obscurité et à leur destruction prochaine : Mais le marbre sur lequel se trouve l'inscription, est renommé parmi les Grecs, comme le remède le plus souverain, et le plus efficace, contre la fièvre intermittente. On y place la malade, il s'y couche, il s'y roule, et tout le monde le croit gueri ; en attendant il efface toujours de plus en plus les precieux caracteres du monument, et peutêtre, hélas ! au moment où je parle, il n'en existe plus aucune trace. La superstition des Grecs fut insensible à mes prières, et leur finesse vigilante déconcerta toutes mes ruses. Au reste, comment aurois-je pu réussir dans une entreprise où l'or des savans Anglois, et les menaces de Hassan, plus éloquentes encore, avoient echoué ?

A peu de distance du village de Jeni-chehr, je me trouvai sur la pointe d'un haut promontoire, qui domine la vaste plaine dont j'ai déjà parlé. Le torrent qui la traverse étoit alors à sec, mais sa largeur et l'irregularité de son lit, annoncent assez ses ravages, et son impétuosité. Un grand marais occupe à droite et à gauche les environs de son embouchure, et s'étend presque jusqu'au pied d'une mauvaise forteresse que les Turcs appellent *Koum-Kalé*, ' le chateau du sable ;' sans doute parcequ' il est bati sur les sables que le torrent amoncéle à son embouchure.

Lorsque je parcourois des yeux ces differens objets, j'apperçois au pied du cap où j'étois assis, deux monticules situés l'un près de l'autre, et absolument semblables à ceux que je venois d'observer sur la crète du promontoire. Un Grec de Jeni chehr m'apprend, que le plus considérable de deux, le plus voisin du rivage de la mer, est appellé *Dios-Tapé*. Ce nom

très

* Travels in Asia Minor, c. 12.

très extraordinaire me fournit, comme on peut le penſer, matière à beaucoup de réflections, que j'eus occaſion de développer, à meſure que j'avançai dans la connoiſſance de la plaine et de ſes monumens; mais je me contentai pour lors de prendre quelques meſures de leur dimenſions, et je continuai ma route.

Le chateau voiſin du cap, bati à l'embouchure du fleuve qui baigne ſes murs, conſiſte en une médiocre enceinte de hautes murailles, flanquées de tours, que les Turcs ont grand ſoin de blanchir, afin de les rendre plus apparentes, et de les expoſer davantage au canon de l'ennemi. Le pied de ces murailles eſt percé de pluſieurs larges embraſures, à travers leſquelles d'énormes canons vomiſſent des boulets de marbre, dirigés à fleur d'eau. Ces canons ſont placés ſur de ſimples madriers. Ils ne peuvent jamais tirer qu'un ſeul coup ſur le même vaiſſeau, parceque le recul les déplace, et il faut des efforts infinis pour leur rendre leur première poſition.

Une pareille batterie n'eſt donc point ſuffiſante pour arrêter une flotte ennemie, qui ſeroit ſecondée par un vent favorable; celle qui ſont ſituées du côte oppoſé, ſur la pointe de la Cherſoneſe de Thrace, et qui ont été baties par le célèbre Baron de Tott, ſeroient ſans doute d'une excellente défenſe, ſi les Turcs ſavoient en faire uſage; mais leurs ennemis naturels, les Ruſſes, n'ignorent pas leur impéritie dans l'art militaire; et ſi dans la guerre qui a précédé celle-ci, les puiſſances intéreſſées à la conſervation de l'Empire Turc, n'avoient pas arrêté leurs ſuccès, ils ſe diſpoſoient à braver le canon des chateaux, et à aller conclure la paix ſous les murs du ſérail.

CHAP.

CHAP. IV.

Voyage de Koum-Kalé au Mont Cotylus, l'un des plus hauts ſommets de la chaine de l'Ida.

LES fatigues du voyage m'ayant forcé de prendre un peu de repos, je m'arrêtai quelques jours dans un *Caravan-ſerai*, au village de Koum-Kalé, ſitué près du chateau. Lorſque je fus en état de continuer mes courſes, je traverſai le fleuve tout près de ſon embouchure, et je l'y trouvai large de plus de trois cents pieds. Dans les marais qui le bordent, je reconnus de petits lacs d'eau douce, et d'eau ſalée ; et je fus frappé de la quantité prodigieuſe de roſeaux et de tamarins que je trouvai ſur ma route, en cotoyant le rivage de la mer.

ENFIN après un demie heure de marche, je vois à une grande diſtance un monticule dans le genre de tous ceux dont j'ai déjà parlé. A meſure que j'en approche, je découvre une large ouverture pratiquée dans ſes flancs, et pluſieurs pans de murailles en ruines, qui paroiſſoient en être la charpente, ou les fondemens. Je m'élance ſous cette voute, je la parcoure avec avidité dans toute ſa longueur, et dans une autre dimenſion tranſverſale, que j'y trouve ; j'examine la nature des materiaux, le ciment qui les unit, et je recueille avec enthouſiaſme le nom très intéreſſant de *Tapé* qu'on lui donne encore.

CE n'eſt pas tout, j'obſerve que ce monument ſe trouve à la pointe d'une avance, ou langue de terre, qui ſe prolonge dans la plaine, exactement en face du cap de Jeni-chehr. Que de brillantes conjectures s'élevent alors dans mon eſprit ! mais encore une fois, il n'eſt pas tems de former un ſyſtème, et les données ne ſont pas ſuffiſantes.

 APRÈS

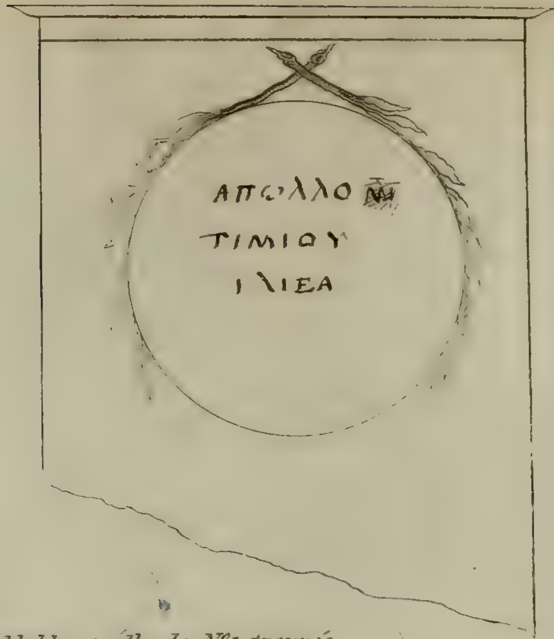
Après avoir jetté un coup d'œil ſur un petit port voiſin, que les Turcs appellent *Karanlik-Limani, le port fermé*, je pourſuis ma route le long du rivage de l'Helleſpont, juſqu'au village de *It-Guelmes.* Je fus ſurpris de la quantité de figuiers ſauvages qui croiſſent aux environs de ce village ; et ce fut la raiſon qui m'engagea à me faire répéter ſon nom, pour découvrir s'il ne feroit point quelque alluſion aux productions du terrein qui l'environne ; un Grec me répondit qu'on l'appelloit indifféremment It-Guelmes ou *Erin-Keu :* Ce dernier nom me rappela celui d'*Erineos*, qui ſignifie " lieu fertile en figuiers ſauvages." Je me ſouvins, en même tems, qu'il y avoit près de la ville de Troye une colline de ce nom, vers laquelle Andromaque cherchoit à diriger l'attention d'Hector, comme étant le ſeul endroit par où la ville pouvoit être attaquée * ; j'allois en conclure que la ville ne devoit pas être éloignée de l'endroit où je me trouvois ; mais il n'y avoit autour de moi, ni Simois ni Scamandre, et j'étois d'ailleurs immediatement ſur les bords de la mer, ſituation qui ne pouvoit s'accorder avec celle de l'ancienne Troye.

Il me parut alors d'autant plus inutile de m'avancer au delà d'*Erin-Keu*, que je n'avois pour toute perſpective qu'une longue chaine de montagnes, qui s'étendoit du côté du nord et du nord-eſt, juſqu' à l'horizon. Je revins à peu près ſur mes pas, dans le deſſein de ſuivre les contours de la vaſte plaine que j'avois admirée du ſommet de l'eminence d'Udjek, et du cap de Jeni-chehr.

Bientôt je deſcends dans un charmant vallon, que les Turcs appellent *Thimbrek-Deré*, *vallée de Thimbrek.* Cette vallée va ſe terminer en s'élargiſſant dans la grande plaine. J'allois remonter juſqu'à ſa ſource le ruiſſeau qui la parcoure, lorſque je fus arreté ſur la rive gauche, près du village de *Halil-éli*, par un énorme monceau de ruines, au milieu deſquelles j'apperçus des bas-

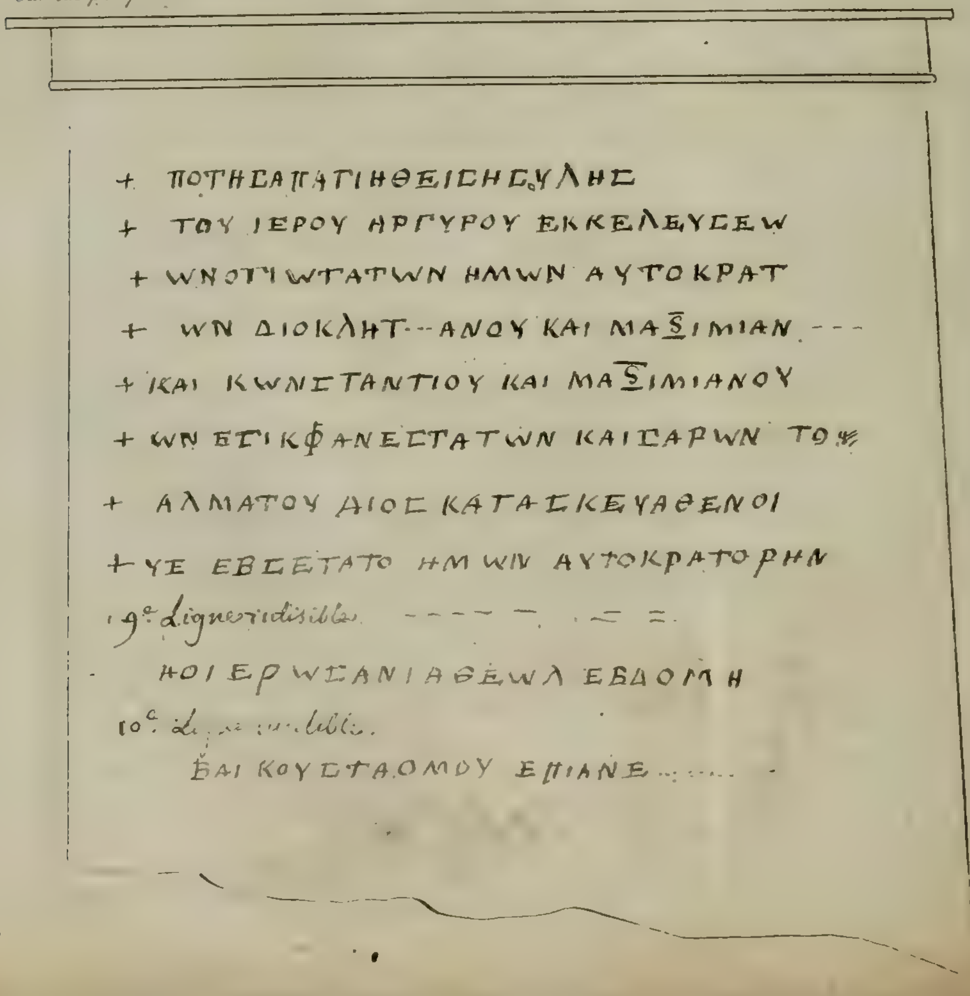
* Iliad. vi. 433. xi. 167. xxii. 145.

Nº 5. Ibidem.



Nº 6. Ibidem

Inscription semblable à celle du Nº 1. trouvée sur un plaque de marbre.



No. 4.
Ibidem

1 ΘΕΩΝ ΕΡΜΙ = Ε ....

2. *illegible*

3 ΤΟΣ ΘΕΟΥΣ ΟΣΙΩΣ ΚΑΙ ΕΥΣΕΒΩΣ

8 ΕΞ ΑΠΠΕΡΙΤΩΝ ΕΤΩΝ ΔΕΜΕΝΩΝ ΧΡΗΜ = ΚΑΙ ΣΠΟΥΔ

9 - - - - - - - - - - - - - - - ΦΙΛΑΝΘΡΩΠΙΑ . . . .

10. ΤΗΝ ΕΙΣ ΤΟΝ ΑΠΑΝΤΑ ΧΡΟΝΟΝ ΑΓΑΘΗ ΤΥΧΗ ΚΑΙ ΣΩΤΗΡΙ ΣΙΤΑΣ:

11 ΕΝ ΑΥΤΟΥ ΕΡΜΙΟΥ ΥΕΡΑΤΙΣ ΤΟΥΣ ΤΕ ΤΕΤΡΑ ΓΕΤΑΜΕΝ. ΧΡΗΜΑΤΑ

12 *illegible*

13. ΕΧΕΙΝ ΕΝΤΕΝ.... ΤΑΣ ΕΙΔΙΑ ΓΕΓΡΑΜΜΕΝΑΣ.

14 ΤΟΙΣ ΜΕ ΘΕΑΥΤΟΥ ΕΚΑΤΟΝ ΚΑΙ ΠΑΡΑΔΟΥΝΑΙ

15 ΕΧΕΙΝ ΕΝΘΕΜΑΤΑ

16 - - - ΟΝ ΑΠΟΔΕΤΗΣ ΠΡΟΣΟΔΟΥ ΓΙΝΕΣΘΑΙ ΤΑΣ ΤΗΝ ΑΛΕΞ

17 ΑΝΔΡΕΙΑΣ ΚΑΙ ΤΩΝ ΙΛΙΑΚΩΝ ΠΟΜΠΗΝ ΚΑΙ ΘΥΣΙΑΣ ΕΝ ΤΩ ΠΑΝΑΘΗΝΑΙΩ

18 ΤΟΥ ΕΤΟΥΣ ΑΠΟ ΤΗΣ ΠΡΟΣΟΔΟΥ

19 ΦΙΛΗΣ ΕΡΕΘΗΣΟΜΕΝΟΙΣ ΦΙΛΑΡΧΑΙ ΕΝ ΤΩ ΠΑΝΑΘΗΝΑΙΩ

20 ΤΑ ΤΡΙΟΒΟΛΟΝΑ - - - ΦΙΛΗΝ ΔΡΑΧΜΑΣ ΕΚΑΤΟΝ

21 - ΕΥΣ ΑΙΒΟΙ ΘΗΛΕΙΑΙ - - - - - - ΕΥΡΥΟΝΤΟΣ

22 - ΣΤΕΜΜΑΤΑ ΠΡΟΦΕΡΕΣΘΑΙ

23 ΤΟΥΣ ΤΩΝ ΦΙΛΑΡΧΩΝ - - - ΕΣ ΤΗΝ ΑΚΟΛΟΥΘΗΝΑΙ

24 ΚΑΙ ΠΡΟΘΥΕΣΘΑΙ ΤΩ ΔΙΙ - - - - - ΕΠΙΓΡΑΨΑΝΤΑΣ

25 ΛΟΤΟΝ ΘΕΣΘΑΙ ΤΗΣ ΔΑΠΑΝΗΣ ΠΡΟΒΑΤΑ ΕΠΙΤΕΛΕΣ - - - ΔΕΚΑ

26 ΤΩΝ ΠΑΝΤΩΝ ΘΕΩΝ ΚΑΙ ΤΩΝ ΗΑΝΤΩΝ ΤΑΣ ΔΕ ΠΟΜΠΗΣ ΕΠΙΜΕΛΗΤΑΣ

27 ΩΣ ΚΑΤΑ ΚΑΛΟΣ ΠΟΜΠΕΥΩΣΙΝ ΩΣ ΚΑΙ ΤΗΝ ΚΑΙ ΤΩΝ

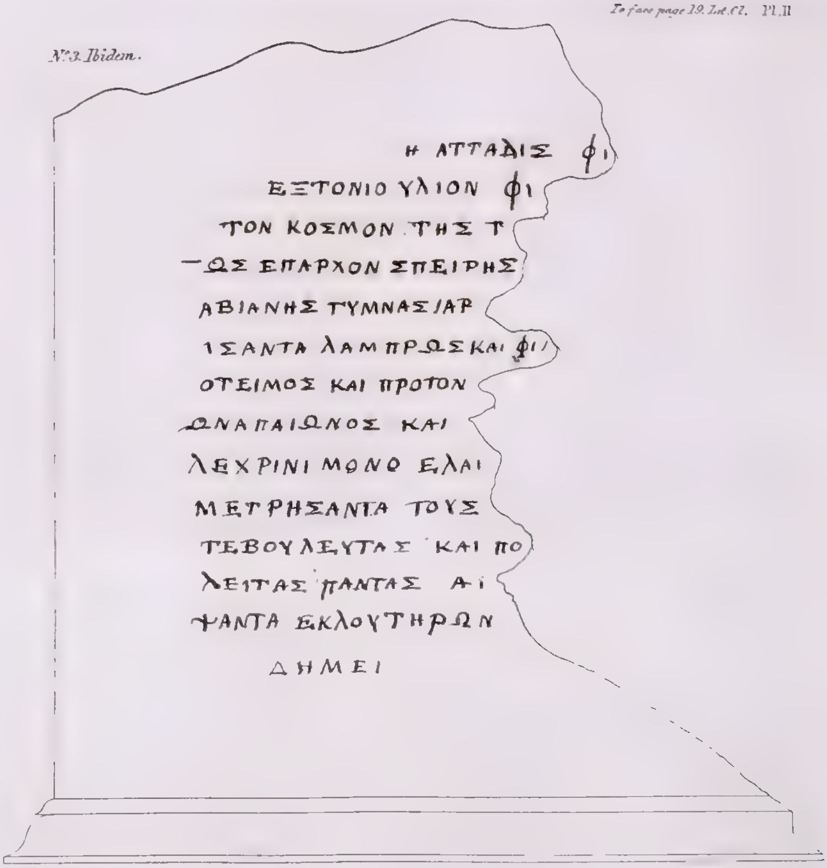
28 ΤΟΥΣ ΤΗΣ ΕΥΤΑΞΙΑΣ ΕΠΙΜΕΛΗΣΟΜΕΝΟΥΣ ΕΠΑΞΙΑ ΠΟΜΠΗΣ ΚΑΘΙΣΤΑΝΑΙ.

29 ΘΥΝΤΑΣ ΤΗΝ ΡΑΒΔΩ .. .. ΚΑΙ ΤΟΥΣ ΚΑΤΑΣΤΑΘΕΝΤΑΣ ΕΧΕΙΝ

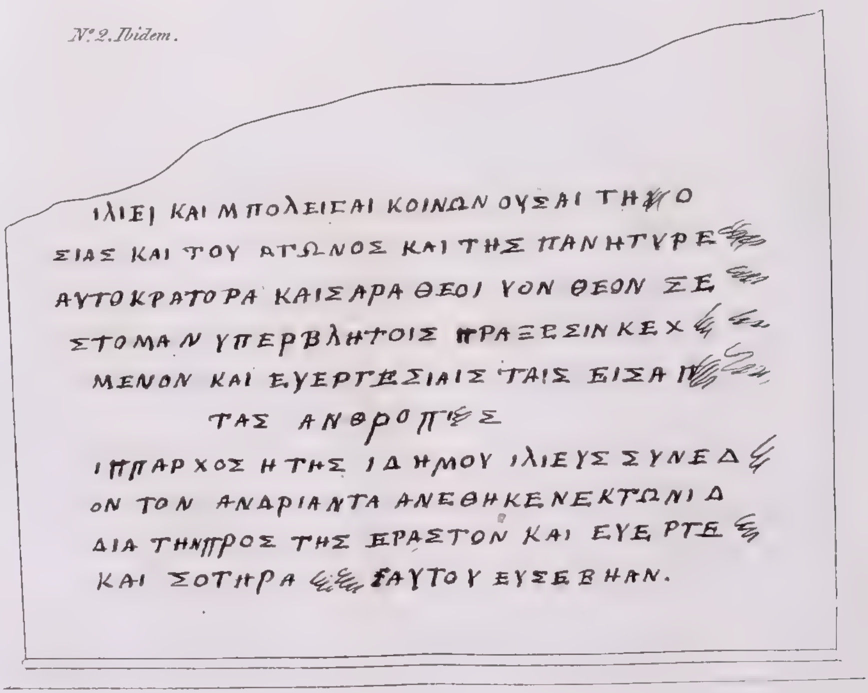
30 ΙΔΙΑ ΤΑΞΙΝ ΕΝ ΟΙΣ ΕΠΙΤΕΤΑΚΤΑΙ ΤΗΝ ΔΕ ΤΗΝ ΠΟΜΠΗΝ.

ΕΚ ΤΩΝ ΒΑΣΙΛΙΚΩΝ

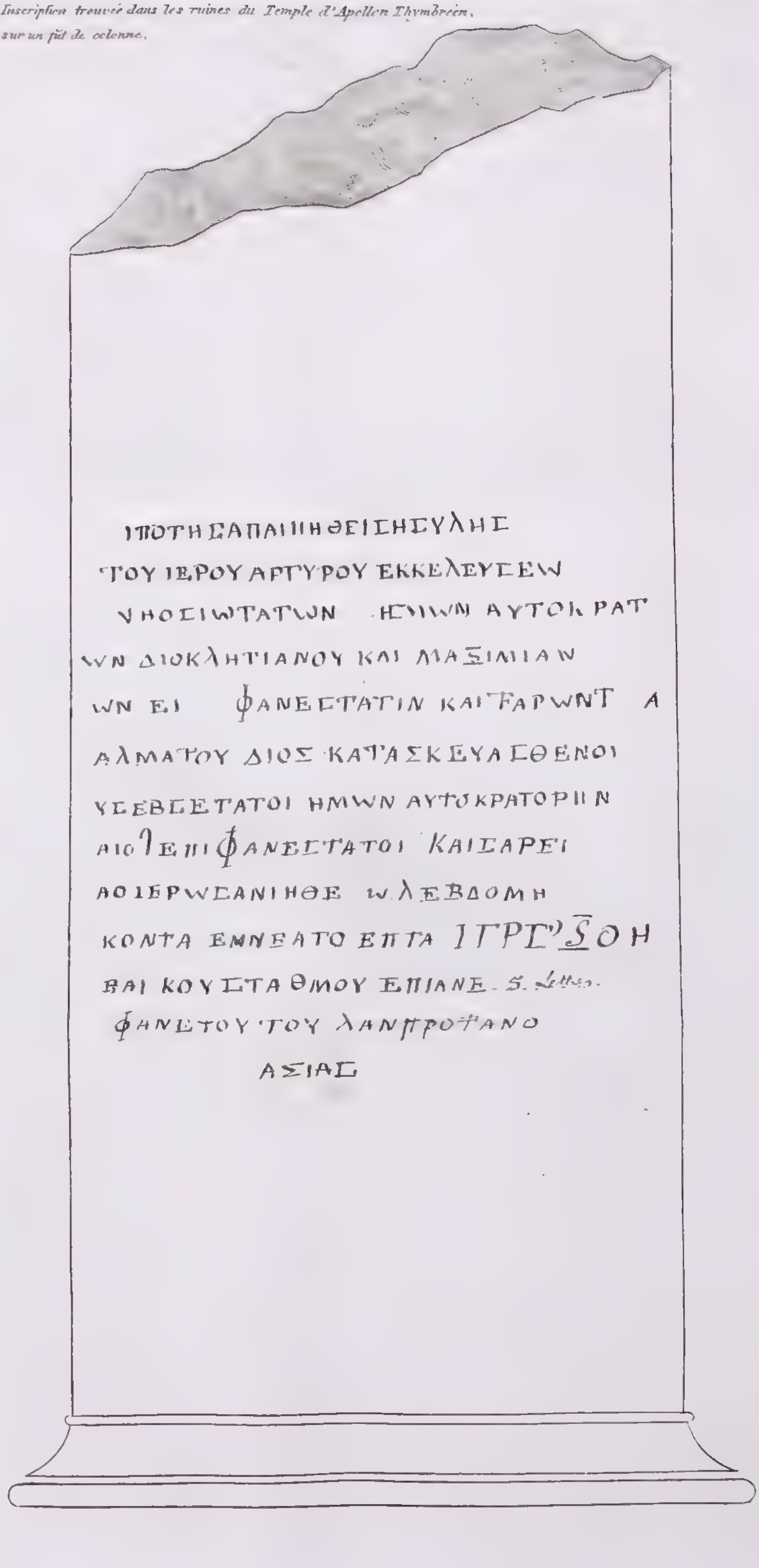
No. 3. Ibidem.



No. 2. Ibidem.



N.° I. Inscription trouvée dans les ruines du Temple d'Apollon Thymbréen, sur un fût de colonne.



bas-reliefs, des colonnes, des chapiteaux, des entablemens, et des inſcriptions.

Sans examiner ſi le monument qui avoit autrefois exiſté dans ce lieu, étoit un temple ou un autre édifice quelconque, preſſé d'ailleurs par les menaces des habitans du village voiſin, qui me ſoupçonnoient de chercher des tréſors parmi ces ruines, je me hâte de recueillir toutes les inſcriptions, bien perſuadé que quelqu'une d'entr'elles contiendroit les titres du monument, ou me fourniroit au moins les moyens de le reconnoître.

L'une de ces inſcriptions fait mention d'une ſtatue d'argent conſacrée à Jupiter par Dioclétien et Maximien, l'autre d'une ſtatue elevée à Auguste au nom des habitans d'Ilium, et des quarante villes d'Aſie, qui célébroient en commun des fêtes ; celle-ci étoit gravée au pied de la ſtatue d'un certain Attalus, fameux lutteur, dont Eschines parle dans ſa lettre ſur la Troade*; celle-là contient le cérémonial des fêtes Panathénées ; la dernière enfin eſt un hommage rendu à Apollon par les habitans d'Ilium.

Toutes ces inſcriptions auroient ſuffi, ſans doute, pour fixer la nature du monument dont je voyois les débris ; mais le caractère de l'architecture et le plan de l'édifice que je démelai ſans beaucoup de peine, achéverent de me convaincre que j'avois decouvert un temple. Il étoit d'ordre Dorique, au moins à l'extérieur ; ſes colonnes avoient dix huit pouces de diamètre. Quelques chapiteaux Conrinthiens jettés çà et là, me firent ſoupçonner que la decoration intérieure pouvoit bien être de cet ordre.

Echappé aux inquiétudes que me causerent les habitans de Halil-éli, pendant le tems que je paſſai ſur les ruines du temple, j'allai fixer la ſource du ruiſſeau qui parcoure la vallée de Thimbrek, et je le ſuivis enſuite juſqu'à ſon embouchure, dans le grand torrent de la plaine que les Turcs appellent *Menderé*.

c 2 Me

* Lettre x. Voyez l'Edition des Orateurs Grecs, par Reiske, vol. iii. p. 679.

Me voila donc encore une fois près de ce grand fleuve, qui paroit defcendre du haut de l'immenfe plaine dont j'ai déjà parcouru une grande partie. J'entreprends de le remonter jufqu'à fa fource, et d'obferver les autres fleuves qu'il peut recevoir dans l'étendue de fon cours. Cette entreprife étoit pénible. Il falloit fe refoudre à fuivre fcrupuleufement toutes fes finuofités; il falloit braver les marais, les broffailles, et les difficultés de toute nature qui fe préfentoient à chaque pas. Auffi le Turc qui me fervoit de guide, me prodiguoit-il fans referve les témoignages les moins équivoques de fa commifération. Il me trouvoit bien fou de venir de fi loin, et de m'expofer à tant de fatigues et de dangers, pour chercher des édifices ruinés, et des fources de rivière. " Infidel," me difoit-il de tems en tems, " n'as-tu point dans ton pays des rivières et de vieilles ma-" fures ?"

Après environ un heure de marche, j'apperçois fur la droite, le lit d'un petit fleuve alors à fec, couvert de plantes et de gazon. J'y entre, et en le fuivant j'arrive aux bords de ce joli ruiffeau qui j'avois traverfé en defcendant du village d'Erkeffighi. Je ne doutai plus alors, que ce petit ruiffeau n'allât autrefois fe joindre au grand fleuve, comme je l'avois préfumé d'abord, ni que le nouveau canal dans lequel il coule maintenant ne fut artificiel.

Mon conducteur voyant le dégré d'intérêt qui j'attachois à connoître l'origine et l'embouchure des rivières, m'apprit que la fource de ce joli ruiffeau n'étoit pas éloignée. Il me montra même du doigt, au fond de la plaine, un groupe d'arbres et de verdure, d'où il m'affura qu'il fortoit.

Avant de vérifier fon affertion, je reviens vers le grand fleuve, au point où je l'avois quitté; et je n'eus pas plutôt fait cent pas, en remontant toujours le long de fes bords, que j'apperçus les ruines d'un pont fabriqué en pierre de taille, et d'une conftruction fi parfaite qu'il ne peut être que l'ouvrage des anciens. En face de ces ruines, fur la droite du fleuve, je vis encore

core une éminence dans le genre de toutes celles que j'avois déjà trouvées ; mais celle-ci étoit beaucoup plus ruinée que les autres. Il falloit même être auſſi accoutumé que je l'étois à la vue de ces monumens pour pouvoir diſtinguer ſa forme ancienne à travers ſes débris.

Bien convaincu par les obſervations précédentes, que les deux fleuves avoient été réunis autrefois dans les environs des ruines du pont, je dirige ma route vers la ſource que mon conducteur m'avoit indiquée. J'atteignis bientôt les rives du petit fleuve ; la limpidité de ſes eaux me frappa de plus en plus ; il coule avec une grande rapidité ſur un fonds de ſable et de cailloux arrondis, entre deux rives verdoyantes, qu'il ne franchit jamais, et qui, au printems, ſont émaillées de fleurs. Le pont ſur lequel je le traverſai étoit un vieux *ſaule* jetté d'un de ſes bords à l'autre, près d'un moulin, où je trouvai pluſieurs Turcs occupés à pecher *des anguilles*.

On ſe figure aiſément tous les ſouvenirs que les differens caractères de ce joli ruiſſeau rappeloient à mon eſprit, et combien j'étois empreſſé d'arriver à ſes ſources. Rien ne ſauroit égaler le plaiſir et la ſurpriſe que j'éprouvai, lorſqu' après avoir traverſé une plaine immenſe, dans laquelle je n'avois pas rencontré un ſeul arbre, je me trouvai au milieu d'une petite forêt de ſaules, de lotos, d'ormes et de peupliers, qui s'étend juſqu'au pied des baſſes collines qui terminent la plaine.

La matière dont ces collines ſont formées eſt une eſpece de *brèche* ou *pouding*, qui à la première vue ne differe en rien d'une maçonnerie. Les pierres qui la compoſent ſont réunies entr'elles par une eſpece de ciment de couleur rougeâtre ; et la Nature a tellement imité l'art dans ce cas particulier, qu'il faut obſerver avec le plus grand ſoin, pour diſſiper l'illuſion qu'elle excite. De nombreuſes ſources d'une eau claire et limpide s'échappent avec rapidité des crevaſſes de ce pouding, et forment, avant de ſe réunir dans un canal, le petit marais qu'on voit dans le vallon voiſin. A l'embouchure de quelques unes de ces crevaſſes, je

remarquai

remarquai des débris de murailles, dont la conſtruction parfaitement ſolide, eſt indubitablement l'ouvrage de quelque peuple plus induſtrieux que les Turcs.

Sur la route quit conduit au village voiſin, à environ quarante pas de la colline dont je viens de parler, je rencontrai une ſource inſolée, et très abondante, qui jailliſſoit du fond d'un baſſin, dont les bords étoient formés par deux pilaſtres de granite, et pluſieurs fragmens de marbre. Quand après je revins dans la Troade vers la fin de Septembre, je remarquai q'une fumée epaiſſe s'élevoit de cette ſource, et couvroit les arbres et les jardins d'alentour ; en y plongeant ma main, je la trouvai chaude, et mon guide m'aſſura qu'elle l'étoit bien davantage encore vers le milieu de l'hiver.

On conçoit facilement que des ſources auſſi abondantes doivent tout fertiliſer autour d'elles ; elles ſe partagent, en effet, en pluſieurs petits ruiſſeaux pour arroſer des jardins delicieux, où elle font croître toutes ſortes de légumes et de fruits ; elles ſe réuniſſent enſuite dans un lit commun, bordé de roſeaux très èpais et très élevés.

Je monte au village voiſin par une pente douce et facile, qui s'éleve inſenſiblement de la plaine ; je traverſe d'abord une vaſte cimetière, dont chaque tombeau eſt orné d'une colonne de marbre ou de granite ; et j'apperçois près de la moſquée un large banc de marbre de Paros, porté ſur deux appuis, dont l'un eſt un triglife du ſtile le plus pur. Voila des monumens de l'art. N'y auroit-il pas en autrefois, quelque ville importante ſur cette colline? le voiſinage d'une plaine fertile et des belles ſources que je viens de voir, dans un pais ou l'eau eſt ſi rare, et par conſequent ſi précieuſe, auroit été ſans doute un puiſſant attrait pour ſes fondateurs.

Le nom de *Bounar*, ou *Pounar-Bachi*, *tête de la ſource*, que les Turcs donnent à ce village, eſt la traduction littérale du mot Grec Κρουνὸς, que je crois avoir rencontré dans Homere, lorſqu'il parle des ſources du Scamandre.—Mais encore une fois, il

n'eſt

n'eſt pas tems de faire des applications; continuons à raſſembler des faits, et à comparer entr' eux les objets que nous avons decouverts; leur ſituation, et leur diſtance reſpective, ne ſont pas moins eſſentielles à connoître, que leurs qualités abſolues.

En graviſſant toujours la colline qui s'éleve, comme je l'ai déjà dit, du niveau de la plaine, et qui s'étend à près d'un mille au delà du village de Bounar-Bachi, je me trouve arreté bruſquement ſur les bords eſcarpés d'un précipice d'une profondeur immenſe. Le torrent qui coule au pied de ce précipice eſt le même qui parcoure la plaine. Quand il eſt en fureur, il couvre de ſes eaux l'étroit vallon bordé de rochers menaçans, que la Nature ſemble avoir deſtinés à contenir ſon impetuoſité. Quand il eſt à ſec, les habitans des villages voiſins profitent de cet heureux intervalle pour cultiver ſes rivages, rendus fertile aux dépens des contrés qu'il a dépouillées de leur fécondité.

Du ſommet de cette éminence que les Turcs appellent *Balli-dahi, montagne du miel*, à cauſe des nombreux eſſaims qui ſe trouvent dans les rochers qui la compoſent, je decouvre la grande plaine dans toute ſon étendue. Sa forme generale me paroit à peu près ſemicirculaire, les deux chaines de collines qui l'entourent ſemblent ſe diriger, l'une vers le cap de Jeni-chehr, et l'autre vers la pointe de In-Tapé-Gheulu. La partie des collines de la droite qui s'étendent entre les villages d'Aktché et de Tchiblak, eſt plus riante et plus agréable que le reſte; j'apperçois au loin les Iles de Tenedos, d'Imbros, de Samothrace, et de Lemnos, le haut ſommet du mont Athos, et la Cherſoneſe de Thrace, ſituée de l'autre côté de l'Helleſpont.

Au moment où j'admirai les avantages de cette ſituation, et la beauté des points de vue, un ſpectacle nouveau vient enchanter mes regards; il faiſoit une vent de ſud très violent, dont j'avois déjà reſſenti les effets dans la plaine, mais qui devint plus ſenſible, à meſure que j'avançai ſur l'éminence de Balli-dahi, expoſée de tous côtés à la fureur des vents, et ſans aucun abri qui puiſſe l'en défendre. La flotte Turque ſecondée de ce vent favorable

vorable doubloit à pleines voiles le cap de Jeni-chehr, et entroit dans l'Hellefpont. HASSAN PACHA qui la commandoit, revenoit victorieux de l'Egypte. Avec une poignée de foldats, et la terreur de fon nom, il avoit defait la nombreufe armée des Mammelucs; il avoit exterminé les Beys rebelles; il emportoit leurs trefors à Conftantinople, et emmenoit leurs femmes en captivité. C'eft ainfi que les coffres du Grand Seigneur fe rempliffent, c'eft par des affaffinats multipliés que l'on fubvient aux befoins fans ceffe d'un grand Empire, qui n'a d'autre loix que la volonté d'un farouche defpote, et d'autres reffources que les fruits de l'exaction.

CES triftes reflexions ne m'occupoient pas alors. J'ignorois que la flotte du cruel HASSAN étoit chargée d'infortunées captives; fi je l'avois fu, la vue de ces beaux vaiffeaux qui m'enchantoit, ne m'auroit infpiré que de l'horreur.

LORSQUE cette flotte eut depaffé le cap, je revins à mes obfervations, et je remarquai avec étonnement, que j'étois entouré de quatre monticules, abfolument femblables à tous ceux que j'avois trouvés fur ma route; l'un d'eux cependant me parut avoir quelque chofe de fingulier dans fa ftructure; je m'en approche, et je vois qu'il n'eft pas comme les autres, un monceau de terre couvert de gazon, mais un énorme amas de cailloux jettés fans ordre les uns fur les autres. Sa forme conique paroit avoir été alterée; il femble qu'on en ait voulu pénétrer l'interieur pour le fouiller.

CE n'eft pas tout; en examinant avec foin la fuperficie du rocher de Balli-dahi, je diftingue des fondemens d'antiques édifices dont la maçonnerie a pris la confiftance du rocher lui-même. Ces fondemens ne font-ils point ceux de quelque ancienne ville; et les colonnes de marbre et de granite qui décorent les tombeaux voifins, ne font-ils point les débris de fes temples et de fes palais? Je n'ai pas encore le droit de le dire; je ne me permit pas même de le préfumer; mais je puis du moins affurer, que s'il y en avoit une, elle fe trouvoit, comme je l'ai déjà remarqué,

marqué, au fond d'une plaine immenſe et fertile, et dans le voiſinage d'une eau limpide, ſalutaire et abondante, qu'elle étoit entourée, preſque de tous côtés, par d'affreux précipices, qui la rendoient imprénable, et que jamais ſituation ne fut plus favorable à l'emplacement d'une ville.

Un quart de lieue au ſud-eſt de Bounar-bachi, on trouve le village d'*Arabler*. La colline qui s'étend entre ces deux villages, et qui fait face à la plaine, eſt le ſeul endroit par où l'on puiſſe atteindre à l'éminence de Bounar-bachi. De tous les autres côtés elle eſt environnée de précipices. Comme le torrent de Menderé étoit à ſec lorſque je deſcendis ſur ſes bords, je me décidai à marcher dans ſon lit, et à continuer de le ſuivre juſqu'à ſa ſource, à travers les troncs d'arbres et les rochers qu'il a roulés ſur ſon paſſage. Des ſaules, des peupliers, des platanes, croiſſent et végétent paiſiblement, au milieu des ravages et de la deſtruction qui les entourent; et quoique à moitié déracinés, ils payent cependant encore à la ſaiſon, peut-être, pour la dernière fois, le tribut de leur foible verdure.

Après avoir marché pendant près de cinq heures, entre le deux chaines de rochers eſcarpés qui bordent le vallon, j'arrive dans une plaine, beaucoup moins étendue que celle que je venois de quitter, et à l'entrée de laquelle, on voit un village conſiderable, que les Turcs appellent *Iné* ou *Ené*. Le pont de bois ſur lequel on paſſe pour y entrer, eſt ſoutenu par deux colonnes de granite. Les murailles du *Caravanſerai* ſont couvertes d'inſcriptions Grèques, mais entièrement indéchiffrables. Tout ſemble annoncer que ce village a auſſi été bati ſur les ruines de quelque ville ancienne; il y en avoit une, à peu près dans ces contrées, que Strabon appelle *Æneas*, et dont le nom n'eſt pas très méconnoiſſable dans celui d'Ené. Cette ville, dit Strabon *, étoit à cinquante ſtades de *Palæſcepſis*.

Le torrent qui baigne les murs du village d'Ené, et qui va ſe réunir au Menderé, prend ſa ſource pres du village de *Babarlar*,

* Geograph. lib. xiii. p. 900. Edit. Amſt. 1707.

barbar, à cinq heures de diſtance vers le midi. Il eſt à ſec pendant une grande partie de l'année, et le pais qu'il traverſe eſt heriſſé de montagnes.

Ne ſeroit-ce point ici le fameux Scamandre dont parle Homere? Le voila qui ſe réunit à un autre fleuve, dont les caractères ſembleroient indiquer le violent Simois. On ſait que ces deux fleuves ſe réuniſſoient autrefois ;—mais que dis-je? les ſources de ce Scamandre ſe trouveroient à quinze lieues de la mer, et des vaiſſeaux de Grecs ; et comment, d'ailleurs, les batailles qui ſe donnoient dans une plaine, entre les rives des deux fleuves, auroient-elles pu ſe donner dans des montagnes impraticables? Je plaindrois l'obſervateur qui ne ſe croiroit pas arreté par ces difficultés qu'Homere lui préſente, et qui réſolu de trouver un Scamandre à quelque prix que ce ſoit, appelleroit à ſon ſecours les convulſions de la Nature, et lui feroit enfanter des montagnes, plutôt que de renoncé à des ſyſtèmes extravagans *.

Une longue et pénible excurſion que je fis dans les environs d'Ené, et aux ſources du torrent qui en eſt voiſin, ne m'offroit aucun objet bien intéreſſant: J'eus ſeulement occaſion d'obſerver quelques ruines au village d'*Eſkuptchu*, que je crois l'ancienne Palæſcepſis ; une mine d'argent que Strabon place, en effet, dans les environs ; et au village de *Kemalli*, une inſcription Latine, en l'honneur de Drusus.

Je revins à Ené, et je continuai mon voyage, en ſuivant toujours le lit du Menderé, et avançant vers la haute montagne, où l'on m'avoit aſſuré qu'il prenoit ſa ſource ; j'apperçois ſur ma route, les differens villages de *Baloukli*, de *Keſil*, de *Tebiaoucb*, et j'arrive enfin à celui d'*Audgiler*, ou *des chaſſeurs*, qui ſe trouve au pied de la montagne que je cherchois depuis ſi long tems, au prix de toutes ſortes de fatigues et de dangers ; car il eſt bon d'obſerver, que tous les montagnards ne ſe reſemblent pas ; et que ceux de la Troade, en particulier, ne ſont pas, à beaucoup près, auſſi maniables,

* Voyez Wood's Deſcription of the Troade, *paſſim*.

maniables, et auſſi doux, que ceux de la Suiſſe, ou du nord de l'Ecoſſe.

CETTE montagne que les Turcs appellent *Kas-Dahi, la montagne de l'oie*, fait partie de la longue chaine de l'Ida, qui s'étend du nord au midi, et dont les rameaux ſont projettés, en s'abaiſſant du côté de l'eſt et de l'oueſt. C'eſt ce mont *Cotylus*, d'où STRABON, trompé par DEMETRIUS, fait deſcendre le Scamandre, qu'il confond avec le Simois *, comme je montrerai dans la ſuite.

PENDANT que je me préparois à en atteindre le ſommet, et que mes guides m'entretenoient des peines qu'ils alloient eſſuyer pour m'y conduire, une pluye affreuſe me força de différer cette grande entrepriſe. Il fallut attendre que les ſentiers devinſſent praticables, et ils ne le furent qu'au bout de trois jours.

ALORS je me mis en marche à travers de bois remplis de bêtes fauves, et de gibier de toute eſpece, qui fait la principale nouritrure, et le principal commerce du village d'Audgiler, entièrement peuplé de chaſſeurs. Après avoir monté pendant quatre heures, et traverſé pluſieurs torrents, qui, groſſis par la dernière pluye, rouloient en s'écumant au fond des précipices, j'atteignis enfin le ſommet de cette montagne, qu' HOMERE a ſi bien dépeinte, en diſant, que " mille ruiſſeaux en découlent, et " que ſes noires forêts ſon remplis de bêtes fauves †."

O! VOUS peintres et poëtes orgueilleux de vos tableaux, je vous attends par un beau jour, ſur le ſommet de l'Ida: Venez y briſer votre orgueil, et vos pinceaux, contre les chef-d'œuvres de la Nature! Comparez donc, ſi vous l'oſez, vos productions meſquines, avec ſes ſublimes ouvrages; n'êtes-vous pas accablés, anneantis, par la grandeur, et l'inimitable variété des objets quelle étale à vos yeux?

QUEL eſt celui de vous, qui hazardera de me peindre ce ciel pur et azure; ces nuages legers et vaporeux qui le ſillonnent;

* Geograph. lib. xiii. p. 898.

† Iliad. viii. 47. xi. 183. &c.

la maſſe impoſante de ces montagnes accumulées ; la blancheur éblouiſſante de la neige qui les couronne ; la profondeur effrayante des précipices ; le fracas du torrent qui ſe briſe contre les rochers ; ces grouppes d'arbriſſeaux, penchés ſur la ſurface de ſes eaux, qu'ils colorient de leur verdure, en s'y réfléchiſſant ; ces blocs monſtrueux de granite, dont les uns ſont ſuſpendus ſur la tête du voyageur, et les autres déjà détachés de la montagne, ſont foiblement ſoutenus ſur les bords du précipice ; les ſommets bouleverſés des collines inferieures, ſemblables aux vagues agitées d'une mer en courroux ; ces fleuves nombreux, qui s'échappent à travers les vallons et les plaines ; et ces deux mers immenſes, la Propontide, et l'Egée, dont les eaux, frappées des rayons du ſoleil, ſemblent enflammer les deux extrémités oppoſées de l'horizon ?

Vous pouvez, comme tous les hommes ſenſibles, éprouver la jouiſſance complete de toutes ces beautés ; votre cœur peut embraſſer la foule innombrable des ſentimens variés, que ce ſpectacle fait naître ; mais vos couleurs ſont trop foibles pour les peindre, et vos cadres trop étroits pour les contenir ; vous pouvez, dans vos ouvrages, ſurpaſſer des rivaux encore plus mediocre que vous, mais ne vous flattez jamais d'atteindre le ſublime de la Nature !

CHAP. V.

Second et troisième Voyage de Constantinople à Troye.

QUOIQUE je me fusse abstenu jusqu'alors, de porter un jugement, et d'arrêter mes opinions, sur la plupart des objets que je venois d'observer, on sent qu'il devoit m'être bien difficile d'écarter tous les souvenirs de ma mémoire, et de me refuser à l'évidence des applications que je pouvois faire. J'entrevoyois de grandes découvertes isolées, mais il n'y avoit point encore d'ensemble dans mon système.

DU mont Ida, je me rends à Constantinople. Lorsque j'y parlai de mon voyage dans la Troade, et des conjectures singulières que je formais, peu s'en fallut qu'on ne me crut l'esprit aliéné ; on s'amusa long tems aux dépens de ce qu'on appelloit *mes Tombeaux*, et *mon Scamandre;* mais les plaisanteries ne me firent point perdre courage. Je retournai bientôt dans la Troade, avec M. CAZAS, l'un des plus habiles dessinateurs de l'Europe, qui arrivoit alors de Palmyre, et qui dans le moment actuel, prépare à Rome, un riche supplément à l'ouvrage de Mr WOOD.

NOUS partimes ensemble de Constantinople, sur un vaisseau Grec, dont le capitaine, fort avancé en age, naviguoit dans l'Archipel depuis sa plus tendre enfance. Je profitai de ses connoissances, pour vérifier dans l'Hellespont la situation de Lampsaque, des ports de Sestos et d'Abydos, de l'ancienne Dardanus, et de tous les fleuves qui se jettent dans ce canal fameux. Mais ce n'est point ici le lieu de faire connoître mes travaux sur cette partie de la Grèce ; je me suis borné au seul tableau de la Plaine

de

de Troye ; le theâtre de l'Iliade, quoique circonfcrit dans un très petit efpace, eft bien digne de m'employer tout-entier.

Nous arrivames donc, M. Cazas et moi, à Koum-Kalé, au moment où le foleil alloit difparoître derrière le haut fommet de mont Athos. Le ciel étoit ferein, et fans nuage ; la couleur azurée des pics d'Imbros, et de Samothrace, contraftoit d'une manière admirable avec le longue faifceaux de lumière, que le foleil lançoit à travers le ciel le plus pur. Ce tableau me rappela ce que j'avois autrefois lu dans Pline, et regardé comme une fable ; ce naturalifte prétend, que l'ombre du mont Athos s'étendoit, dans certaines faifons, jufques dans le marché de Myrina, ville de l'île de Lemnos, fituée à quatre-vingt fept milles du mont Athos.

Le témoignage de Pline à ce fujet, ne m'avez pas paru plus digne de fois que celui de Strabon, qui affure, que les habitans du fommet de la même montagne, voyent le foleil levant, trois heures plutôt que ceux qui habitent le rivage de la mer. J'inclinois fort à ranger ces deux affertions fur la même ligne, lorfqu'en jettant les yeux dans l'oueft, j'apperçus un immenfe cône d'ombre, dont la pointe étoit au fommet de l'Athos, et dont la bafe projettée horizontalement, fembloit rafer la furface de la mer, et fe diriger vers l'île de Lemnos. Dans peu de momens, cette ombre s'éleva dans l'atmofphere, fe diffipa, et perdit peu à peu fa forme, à mefure que le foleil defcendit au deffous de l'horizon. Il n'en fallut pas davantage pour juftifier Pline à mes yeux, mais Strabon ne l'eft pas encore, et ne fauroit l'être.

La vigilance des Turcs, paroiffoit devoir être un grand obftacle aux operations géographiques, que je voulois entreprendre ; pour y échapper, je m'avifai d'un ftratagème, qui me procura la liberté de déployer mes inftrumens dans tout le pays, fans éprouver aucun défagrément. Je plantai hardiment mon graphomètre fous le canon même du chateau : Auffitôt les Janiffaires m'entourent ; fans paroître intimidé de leur préfence,

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je tachai de fixer leur attention ſur la bouſſole du graphomètre, qu'ils connoiſſent comme une inſtrument de marine, et je leur demandai la permiſſion de la vérifier avant de me mettre en mer. Les Turcs ont une confiance, et une crédulité, qui ſont l'apanage de leur grand caractère, et le réſultat de leur profonde ignorance. Chacun des Janiſſaires s'empreſſe de m'être utile; l'un porte le pied de l'inſtrument, l'autre la chaine, un troiſième les piquets; et tous ſe réuniſſent, pour m'aider à faire un ouvrage pour lequel ils m'auroient empalé, s'ils en avoient connu les funeſtes conſequences.

Cette ruſe que j'employai dans le reſte de la Troade, fut par tout ſuivie du même ſuccès. M. Cazas deſſina tous les monumens; mais il s'abſtint pour le moment, d'y placer des figures, depuis qu'un Emir * lui eut prouvé, d'un air menaçant et courroucé, qu'il ſeroit comptable devant Dieu, de tous les petits hommes qu'il engendroit avec ſon pinceau.

Ce ſecond voyage, et un troiſième, que je fis enſuite, dans la Troade, ne laiſſerent pas que de me fournir de nouvelles idées, et de rectifier les erreurs que j'avois pu commettre dans le premier.

CHAP.

* Secte particulière de Turcs, qui ſe croient de la famille de Mahomet; et qui ſont pour cette raiſon, plus orgueilleux, et plus fanatiques que les autres.

CHAP. VI.

Hiſtoire de plus célèbres voyageurs, tant anciens que modernes, qui ont viſité la Plaine de Troye.

IL eſt tems maintenant, Meſſieurs, de vous communiquer mes opinions et mes conjectures ſur les differens objets que je viens de décrire; mais avant tout, pour vous préparer à les adopter ſans répugnance, et à ne pas vous effrayer de leurs ſingularité, je vais m'étayer d'abord du témoignage des plus célèbres voyageurs tant anciens que modernes.

La longue durée de la guerre de Troye, n'eſt pas, comme l'on ſait, une fiction de la poéſie, c'eſt une vérité de l'hiſtoire. Pendant dix ans, les peuples de la Grèce ravagerent la côté d'Aſie, et les îles qui y ſont adjacentes. La capitale de la Troade ne fut pas toujours l'objet de leu s combats; ils y revenoient, ſans doute, par intervalle, et ce ne fut, à ce qu'il paroit, que la denière année qu'ils l'attaquerent avec leurs forces réunies. Fut-elle priſe, ou réſiſta-t-elle à tous les efforts des Grecs, comme quelques hiſtoriens l'ont prétendu, c'eſt ce que je ne me flatte pas de décider; mais ce qu'il y a de certain, c'eſt que pendant cette dernière campagne, il périt, de part et d'autre, un grand nombre de guerriers illuſtres, auxquels, ſuivant l'uſage, on éleva des monumens, au milieu même des batailles.

Le grand intérêt de cette guerre, dut mettre en mouvement la Grèce et l'Aſie, pendant qu'elle dura; lorſqu'elle fut terminée, les ſoldats, et les généraux, qui en avoient été les acteurs, à leur retour dans leur patrie commune, durent en faire

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la matiere de leurs récits, et l'inſtrument de leur renommée.

L'HISTOIRE et la poéſie s'emparerent auſſitôt de ces grands évenemens, pour les tranſmettre à la poſtérité. DICTYS de Crète et DARÈS de Phrygie publierent, dit-on, les premiers, la relation de cette guerre, dont ils avoient été les acteurs, et les témoins.

BIENTÔT les guerriers qui avoient péri ſous les murs de Troye, partagerent les honneurs reſervés aux dieux ; l'encens fuma ſur le tombeau d'ACHILLE, et la plaine de Troye devint un vaſte temple, où les voyageurs de toutes les nations, ſe faiſoient un devoir religieux, d'offrir un ſacrifice avant d'entrer dans l'Helleſpont.

IL me ſemble voir le grand HOMERE, abordant pour la première fois ſur ces rivages fameux, et rendant à l'ombre d'ACHILLE le plus digne hommage qu'elle ait jamais reçu ; je le vois marchant d'un air grave et penſif, entre les rives du Simois et du Scamandre : Son œil brulant embraſſe avec avidité tous les objets qui l'entourent ; mille ſouvenirs ſe préſentent à la fois à ſa mémoire ; ſon cœur s'attendrit ; ſon imagination s'enflamme ; le plan de l'Iliade eſt formé !

Ut Ducis implevit viſus veneranda vetuſtas— *

HÉRODOTE eſt, je penſe, après HOMERE, le plus ancien auteur qui nous ait parlé de la Troade. Suivant lui, la plaine, et les environs de Troye, après la guerre, fut long tems un ſujet de diſcorde, entre les Athéniens et les Mitylénéens. Ceux-ci ſoutenoient que leur droits à la poſſeſſion de la Troade n'etoient pas moins fondés que ceux des autres Grecs, qui avoient contribué, avec MÉNÉLAUS, à arracher HÉLÉNE de la main des Troyens.

* LUCAN. Pharſ. Lib. ix. 987.

Je n'ai point d'épreuve, que ce père des hiſtoriens ait fait le voyage de Troye ; mais j'oſe aumoins aſſurer, que la deſcription qu'il donne de la marche de Xerxès, eſt parfaitement d'accord avec ma carte. " L'armée de Xerxès, (dit-il), en " quittant la Lydie, marcha vers le fleuve Caicus, et la Myſie. " Laiſſant enſuite le mont Cana ſur la gauche, elle avança du " Caicus par Atarné, vers la ville de Carina. De-là, elle con- " tinua ſa marche à travers la plaine de Thébé, et paſſa par la " ville Adramythium, et d'Antandros ; dirigeant enſuite ſes pas " vers la partie gauche du mont Ida, elle entra dans le territoire " des Troyens. Pendant qu'elle étoit campée au pied de cette " montagne, un orage affreux, qui s'éleva pendant la nuit, fit " périr un nombre conſiderable de ſoldats. Quand l'armée " arriva au Scamandre, ce fut la première rivière qu'elle ren- " contra depuis Sardes, dont les eaux ne ſuffirent pas pour les " hommes et les chevaux. Xerxès monta ſur la Citadelle de " Troye, àfin d'obſerver la ſituation de la place, et s'informer " des particularités qui y avoient rapport. Il ſacrifia mille beufs " à Minerve Iliade, et les Mages offrirent des libations aux hé- " ros. Dans la nuit qui ſuivit ces cérémonies, une allarme " s'étant repandue dans le camp, auſſitôt que le jour vint à pa- " roître, l'armée ſe mit en marche, ayant à gauche les villes de " Rhetée, d'Ophrynéum, et Dardanus voiſine d'Abydos ; et à la " droite le pays des Gergithes-Troyens."

L'orateur Eschines fut conduit à Troye par la ſimple curioſité, et pour y rechercher les monumens mentionnés dans l'Iliade. Il avoit pour compagnon de voyage un jeune homme dont la conduite légere et imprudente l'empêcha d'exécuter ſon projet, et l'expoſa même aux plus grands dangers. L'aventure qui les obligea tous deux de quitter la Troade avec la plus grande précipitation eſt véritablement déplorable. Elle eſt racontée en détail par Eschines lui-même dans la dixième des lettres attribuées à cet orateur*.

" Alexandre,

* Vid. Oratores Græci, Edit. Reiſke, Vol. iii. p. 679.

" ALEXANDRE, (d'après les differens auteurs dont le té-
" moignage a été recueilli par FREINSHEMIUS dans ſon ſupplé-
" ment à QUINTE CURCE), arrivé à Seſtos, envoya la plus
" grande partie de ſes troupes à Abydos, de l'autre côté du
" rivage, ſous la conduite de PARMENION, et il lui donna cent
" ſoixante vaiſſeaux de guerre, et pluſieurs autres de charge.
" Quant à lui, il alla avec le reſte à Eléonte, qui eſt conſacrée
" à PROTÉSILAUS, de qui l'on voit la ſépulture, ſous un petit
" tertre, environné d'ormes d'une nature merveilleuſe ; car les
" feuilles qui naiſſent aux branches tournées du côté de Troye
" tombent en même tems qu'elles ſont ouvertes, bienque toutes
" les autres conſervent leur verdure, comme pour faire ſouve-
" nir de la funeſte avanture de ce héros, qui paſſa en Aſie avec
" les Grecs dans une floriſſante jeuneſſe, et qui fut la première
" victime de la guerre des Troyens. Au reſte, ALEXANDRE lui
" fit des ſacrifices mortuaires, et le pria de permettre qu'il en-
" trât dans une terre ennemie, ſous des auſpices plus heureux
" qu'il n'y étoit entré lui-même. De-là, il ſe rendit avec ſoix-
" ante vaiſſeaux à Sigée, et vit ce port qui fut mis en réputa-
" tion par les Grecs, dont il avoit reçu la flotte du tems de la
" guerre de Troye. Comme il voguoit déjà au milieu de
" l'Helleſpont, étant lui-même le pilote du vaiſſeau que le por-
" toit, il immola un taureau à Neptune et aux Neréides, et pour
" faire une offrande aux dieux marins, il jetta dans la mer le
" vaſe d'or dont il avoit fait les libations. Lorſqu'il fut arrivé
" au port, il lança un dard ſur le rivage, et ſauta le premier à
" terre, prenant les dieux à témoins qu'il ne vouloit avoir
" l'Aſie que par une guerre légitime. Enſuite il fit élever des
" autels en l'honneur de JUPITER Défenſeur, de MINERVE et
" d'HERCULE, au même lieu où il étoit deſcendu à terre, et
" commanda que l'on en dreſsât auſſi à l'endroit où il étoit parti
" de l'Europe.

" AINSI il prit ſon chemin par la campagne, où l'on voit en-
" core des marques de l'ancienne ville de Troye. Il y con-

" ſidéra curieuſement les reſtes de tant d'ouvrages héroiques ;
" et lorſque quelqu'un des habitans lui eut offert la lyre de
" PARIS, il repondit, *qu'il ne faiſoit grand cas de cet inſtrument*
" *de lâches et molles voluptés, mais qu'on lui feroit plaiſir de lui*
" *donner la lyre d'*ACHILLE, *ſur laquelle il faiſoit réſonner les lou-*
" *anges des grands hommes, avec la même main dont il ſurpaſſoit*
" *leurs actions.*

" DE plus, comme il avoit une admiration particulière pour
" ACHILLE, de qui il ſe glorifioit d'être deſcendu, il courut
" tout nud avec ſes favoris à l'entour de ſon ſépulcre ; il l'oig-
" nit d'huile, et mit deſſus une couronne. EPHESTION cou-
" ronna auſſi la ſépulture de PATROCLE, pour témoigner qu'il
" avoit la même place dans l'amitié d'ALEXANDRE que PA-
" TROCLE dans celle d'ACHILLE. Au reſte, parmi les diſcours
" qu'ALEXANDRE fit d'ACHILLE, il dit : *Qu'il l'eſtimoit dou-*
" *blement heureux d'avoir eu, durant ſa vie, un véritable et fidel ami,*
" *et d'avoir trouvé, après ſa mort, un excellent poëte pour célébrer ſes*
" *louanges.* Il fit auſſi des ſacrifices à tous les autres héros,
" dont on voyoit les tombeaux dans cette contrée *."

LORSQUE les Romains paſſerent la première fois en Aſie, pour chaſſer ANTIOCHUS du pays qu'il occupoit en deçà de mont Taurus, ils ne furent pas inſenſibles aux charmes du pais dont leurs ſouverains prétendoient tirer leur origine. Mais le cruel FIMBRIA montra des diſpoſitions oppoſées à celles de ſes concitoyens. Ayant pris le commandement de l'armée, après la mort du conſul VALERIUS FLACCUS, qu'il avoit fait périr en Bithynie, il s'avança vers Ilium. Les Troyens à ſon approche, fermerent les portes de leur ville, et envoyerent, en même tems des députés à SYLLA, en lui propoſant de ſe rendre à lui. SYLLA leur conſeilla de ſe ſoumettre à leur vainqueur FIMBRIA ; il leur promit de venir bientôt à leur ſecours ; et leur rappela, pour les encourager, que les Romains tiroient leur origine des Troyens :

* Supplement. in Q. CURTIUM, Lib. ii. cap. 3.

Troyens : En même tems il envoya des députés à FIMBRIA pour l'engager à traiter les Troyens avec douceur. L'orgueilleux FIMBRIA piqué de cet ordre, affiégea, fur le champ, la ville ; et après s'en être rendu maître, dans l'efpace de onze jours, comme il fe vantoit en préfence d'un Troyen de s'être emparé dans fi peu de tems d'une ville qu'AGAMEMNON, avec mille vaiffeaux, n'avoit pris qu'après dix ans de fiége ; " il eft vrai," répondit le Troyen, " mais nous n'avions pas un HECTOR " pour nous défendre." FIMBRIA rafa la ville, et maffacra tous fes habitans. SYLLA ayant fait fa paix avec MITHRIDATE, fit marcher fon armée contre FIMBRIA, qui, réduit à une fituation défefpérée, fe donna la mort. SYLLA fit tous fes efforts pour apporter quelques confolations aux malheureux Troyens, et leur donna toute forte de marques d'interêt et de bienveillance.

CÉSAR digne rival d'ALEXANDRE, et qui l'imita même jufque dans fa paffion pour HOMERE, voulut renouveller l'alliance qui l'uniffoit avec les Troyens. Il leur accorda de nombreux privileges, et les combla de bienfaits. S'il en faut croire l'auteur de la Pharfale, ce guerrier purfuivant POMPÉE pénétra dans la Troade pour en vifiter les monumens :

Sigeafque petit famæ mirator arenas
Et Simoentis aquas, et Graio nobile bufto
Rhœtion, et multum debentes vatibus umbras *.

POMPÉE enleva la ftatue d'AJAX, qui étoit dans le temple élevé près de fon tombeau, et la tranfporta en Egypte. AUGUSTE la fit reftituer aux Troyens dans la fuite. JULIE, fille de cette Empereur, manqua, dit-on d'être noyée dans le Scamandre, en parcourant la plaine de Troye : AGRIPPA fon époux fe montra fort fenfible à cet accident, et en témoigna fon indignation aux Troyens comme s'ils avoient pu en être refponfables.

TOUS

* LUCAN. Lib. ix. 961.

Tous ces illuſtres voyageurs ne nous ont rien appris de la Troade, ſi non que ſes monumens attiroient, encore de leurs tems, la curioſité des plus grands perſonages. Du reſte, les princes, et les femmes d'alors voyageoient comme aujourd'hui, par ambition, par vanité, ou pour ſe dérober à l'ennui. Alexandre honoroit Achille, pour établir ſa parenté avec ce héros, et faire accroire qu'il avoit hérité de ſon courage. La maiſon de Jules exemptoit les Troyens d'impôts, pour rappeler qu'elle étoit iſſue de celle de Priam ; et lorſque l'infame Julie les fit accabler d'une injuſte amende, c'eſt, ſans doute, parcequ'elle ne reçut pas des Troyens les honneurs qu'elle ſe croyoit en droit d'en attendre. Revenons aux voyageurs éclairés dont les journaux ont triomphé des ſiècles pour arriver juſqu'à nous.

C'est une choſe bien étrange, que les deux plus grands géographes de l'antiquité, Pausanias et Strabon ne ſoient jamais allés dans la Troade. Le premier en parle ſur le rapport d'un certain Myſien, qui lui racontoit des prodiges touchant le tombeau d'Ajax ; le ſecond s'appuye ſur le témoignage d'un certain Demetrius de Scepſis, auquel il ne paroit pas avoir une grande confiance ; qu'il accuſe de contradiction ; qu'il ne trouve point d'accord avec Homere ; mais dont il a cependant adopté la deſcription, ſans doute, parcequ'il n'a pas pu s'en procurer de plus exacte.

Il ne m'a pas été poſſible de ſuivre plus avant dans l'hiſtoire ancienne, les monumens, et les fleuves de la Troade. Je laiſſe aux érudits le ſoin de continuer ces recherches, et de remplir, s'ils le peuvent, par de nouveaux témoignages, l'immenſe lacune que la barbarie du bas Empire ſemble avoir laiſſée, entre le dernier des auteurs anciens qui a parlé de la Troade, et le premier des voyageurs modernes. Je ne ſerois point, au reſte, étonné qu'après l'établiſſement du Chriſtianiſme, les temples et les tombeaux des guerriers ne ſoient tombés dans l'oubli : Ils ont du ceſſer d'attirer l'hommage comme les autels d'un culte ſacrilége.

lége. Tout le monde ſait avec quel zèle CLEMENT d'Alexandrie s'éleva contre cette eſpece d'idolatrie, et avec quelle véhémence il reprochoit aux nouveaux Chrétiens de prodiguer à ces nombreux tombeaux un encens qui n'étoit du qu'à la Divinité *.

MAIS pourquoi les prêtres du bas Empire n'ont-ils pas renverſé ces monumens? Pourquoi n'en ont-ils pas effacé juſqu' à la trace? C'eſt qu'ils connoiſſoient la vénération des Grecs pour les ſépultures, et ç'auroit été peut-être le plus ſûr moyen de les ramener à leur ancien culte, et de les détourner du nouveau, que d'oſer porter la main ſur les tombeaux de leurs guerriers.

LES Turcs devenus maîtres de la Troade, par la deſtruction et la conquête de l'empire, portent peut-être plus loin le reſpect pour les morts que les Grecs dont ils ont triomphé. Le prétexte de la commodité publique ou particulière, ne ſuffit pas chez eux, comme chez nous, pour violer les tombeaux; malheur à celui qui ſe rendroit coupable de cette profanation! Auſſi s'oppoſent-ils avec la plus grande vigilance aux enterpriſes des étrangers curieux, qui cherchent à ſonder ces monticules ſacrés, dont la tradition leur a fait connoitre l'uſage, et auxquels ils ont conſervé le même nom qu'on leur donnoit dans la plus haute antiquité.

LE Docteur POCOCKE eſt, je crois, le premier des modernes qui ait pénétré dans la Troade, ou dumoins, qui en ait tenté la deſcription. Cet article de ſon ouvrage, quoique rempli de fautes et d'obſcurité, m'a cependant guidé très utilement dans mes recherches. Il avoit vu la plus grande partie des tombeaux; il avoit vu la vallée de Thymbra, et le fleuve Thymbrius; mais il ne leva pas la carte du pays; et trop ſcrupuleux admirateur de STRABON, il aima mieux ſe laiſſer égarer par ce géographe, que de s'en rapporter à ſes propres yeux, qui l'auroient probablement conduit à ſe trouver d'accord avec HOMERE, s'il avoit fidèlement obſervé la Nature. De ſon tems, au reſte, il n'étoit peut-être pas facile, ni prudent, d'expoſer des inſtrumens de

géometrie,

* Cohortatio ad Gentes, cap. iii.

géometrie, à la face des Turcs ; ils n'avoient pas encore connu le joug des Russes, et ils n' toient pas aussi traitables qu'ils le sont aujourd'hui.

Le Docteur Richard Chandler, de l'université d'Oxford, membre de la Société des Antiquaires de Londres, parut, il y a quelques années, dans la Troade, à la suite de Pococke. La hardiesse, et la franchise avec laquelle ce savant et estimable voyageur parle des tombeaux d'Achille et de Patrocle, d'Antiloque et d'Æsyetès, contraste d'une manière frappante avec la timide circonspection de Pococke. " Ces monumens," dit celui-ci, " pourroient bien être de la plus haute antiquité ; le " grand est *peut-être* le tombeau d'Ac ille et les deux autres " ceux de Patrocle et d'Antiloque."

" Les deux éminences," dit celui-là, " que j'apperçois dans " la vigne, sont les tombeaux d'Achille et de Patrocle ; le " troisième est celui d'Antiloque fils de Nestor ; je distingue " du côté opposé le tombeau d'Ajax, et à une plus grande di-" stance le tombeau d'Æsyetès."

Quand on a lu l'ouvrage du Docteur Chandler, on ne sauroit le soupçonner d'avoir avancé légèrement son opinion sur les monumens dont il parle. Il a ses preuves, j'en suis sûr, mais je regrette véritablement qu'il ait paru mettre si peu d'importance à des objets qui demandoient la discussion la plus approfondie ; je le blâme d'avoir assez compté sur la crédulité de ses lecteurs, ou sur leur instruction, pour imaginer qu'ils adopteroient sur sa parole les prodiges qu'il leur annonce ; je le blâme enfin de ne s'être pas appuyé des conjectures de son célèbre compatriote. Au reste, je trouve dans la réunion de leurs respectables témoignages une autorité dont je vais m'armer avec confiance, et j'ose espérer avec succès, contre la défiance et l'incredulité.

J'aurois desiré de toute mon âme pouvoir aussi appeler à mon secours, les observations de Mr Wood, le célèbre auteur du

dù voyage de Palmyre, et de l'Effai fur le génie d'HOMERE; mais je ne crains pas de le dire, Meffieurs, parce que je le prouverai bientôt,—Mr WOOD s'eft égaré dans la Troade.

CHAP. VII.

Erreur de Strabon fur le Scamandre.

STRABON ne pouvant parler de la Troade à fes lecteurs d'après fes propres obfervations, parce qu'il n'y étoit jamais allé, a cherché à s'appuyer de celles de quelque géographe éclairé. DEMETRIUS de Scepfis fut celui dont il adopta la defcription; mais la manière dont il s'y prend pour infpirer aux autres de la confiance en cet auteur, femble prouver qu'il en avoit peu lui-même. " Il y a de la contradiction dans ceci," dit-il dans un endroit, " mais j'approuve le refte; et je crois " que dans beaucoup de chofes il faut s'en rapporter à DEMETRIUS de Scepfis, homme inftruit, né fur les lieux, et qui " d'ailleurs a pris tant d'intérêt à la fcene de l'Iliade, qu'il a " compofé trente livres fur les foixante vers d'HOMERE qui ont " rapport à la plaine de Troye."—" Ecoutons," ajoute-t-il encore ailleurs, " DEMETRIUS de Scepfis, cet homme verfé dans " la connoiffance de la Troade, puifqu'il y eft né; il nous apprend que le Scamandre prend fa fource dans le mont Cotylus, avec le Granique et l'Æfepus. Il avoue, de plus, que " le Scamandre coule vers l'occident, tandis que les deux autres coulent vers le nord."

Ayant une fois adopté la doctrine de cet obſervateur, Strabon doit maintenant chercher à l'accorder avec les poëmes d'Homere ; il en ſent la néceſſité, et il a la bonne foi de ne pas en diſſimuler la difficulté. " Au reſte," dit-il, " les vers ſui-" vans d'Homere fourniſſent matière à une grande diſcuſſion :

Κρουνὼ δ' ἵκανον καλλιῤῥόω, ἔνθα δὲ πηγαὶ
Δοιαὶ ἀναΐσσουσι Σκαμάνδρου δινήεντος.
Ἡ μὲν γάρ θ' ὕδατι λιαρῷ ῥέει, ἀμφὶ δὲ καπνὸς
Γίνεται ἐξ αὐτῆς, ὡσεὶ πυρὸς αἰθομένοιο·
Ἡ δ' ἑτέρη θέρεϊ προρέει εἰκυῖα χαλάζῃ,
Ἢ χιόνι ψυχρῇ, ἢ ἐξ ὕδατος κρυστάλλῳ*.

" Ils arriverent enfin aux deux belles ſources, je veux dire, à " l'endroit où jailliſſent les deux ſources du Scamandre ; car " cette rivière a deux ſources : L'une eſt chaude, et il s'en éleve " de la fumée, comme autour de la flamme : L'autre, en été, " eſt froide comme la grèle, la neige, ou la glace tranſparente." " Ceci," dit Strabon, " préſente une difficulté. On ne " trouve point de ſources chaudes dans cet endroit ; et la " ſource du Scamandre n'eſt pas là, mais dans la montagne. " D'ailleurs il n'y en a pas deux ; il n'y en a qu'une. Il eſt " donc probable que la ſource chaude a diſparu, mais que la " ſource froide s'échappant du Scamandre par un paſſage ſou-" terrain, paroit près de là ; ou bien l'on peut imaginer en-" core, que ce courant d'eau a été appelé la ſource du Scaman-" dre, parce qu'il eſt voiſin de ce fleuve ; c'eſt en effet, de " cette manière, que l'on peut dire qu'une rivière a pluſieurs " ſources."

Cette application eſt ſi miſerable, ſi obſcure, ſi inintelligible, qu'on ne ſait lequel on doit blâmer le plus, de Demetrius de Scepſis, qui commet une erreur groſſière, ou de Strabon qui cherche à la conſacrer.

Le

* Iliad. xxii. 147.

Le mont Cotylus, où Demetrius place la fource du Scamandre, au lieu de celle du Simois, eft à quinze lieues du rivage de la mer. C'eft le Kas-dahi, ou *la montagne de l'Oie,* dont j'ai fait la defcription dans mon journal. Il eft, après le mont Gargara, le fommet le plus élevé de la chaine de l'Ida, peuplé de *bêtes fauves,* comme au tems d'Homere, et environné d'autres montagnes, dont les rameaux s'étendent à l'oueft jufqu'à la mer, et à l'eft vers la Myfie. L'armée Grecque n'a jamais pu faire la guerre au milieu de ces impraticables montagnes. Ainfi, d'après Strabon, ou plutôt d'après Demetrius, il faut fuppofer qu'Homere nous a trompé, quand il nous a dit que les plus grandes batailles fe donnoient entre les rives des deux fleuves; que la ville de Troye étoit fituée près des fources du Scamandre, et que le Grecs alloient fouvent dans le même jour jufqu'au pied des murailles, et revenoient à leur camp.

J'aurois pu me difpenfer d'entrer dans ces détails, et de m'étendre fi au long fur la réfutation de Strabon, il me fuffifoit de me trouver d'accord avec Homere, de prouver que les fources du Scamandre font encore aujourd'hui dans la plaine de Troye, à l'endroit où elles doivent être pour fatisfaire à tous les incidens de l'Iliade, et que le fleuve qu'elles forment, a tous les caractères que le poëte lui donne. Mais après avoir expofé quelques unes des erreurs dans lequel Strabon eft tombé, en accordant fa confiance à Demetrius, je rendrai maintenant juftice à certaines parties de fa defcription que j'ai trouvées exactes; car quoique cet auteur juftement célèbre, ne reconnoiffe pas les fources du Scamandre, et les rejette à dix lieues de la plaine où elles font à prefent, et où elles étoient indubitablement de fon tems, il n'en a pas moins montré une connoiffance fuffifante de fon fujet dans beaucoup d'autres points.

CHAP. VIII.

Examen de quelques paſſages de Strabon.

IL ſuffit de jetter les yeux ſur la carte de la plaine de Troye pour reconnoître auſſitôt combien cette carte eſt d'accord avec la deſcription de STRABON, qui, quoique exacte à beaucoup d'égards, ne ſauroit cependant paroître intelligible dans bien des cas, aux yeux mêmes de ſes plus zélés admirateurs.

" DANS cet endroit," dit-il avec DEMETRIUS, " deux chaines
" de montagnes recourbées ſe détachent de la grande chaine de
" l'Ida, et s'étendent vers la mer, l'une dans la direction du Cap
" Sigée, et l'autre dans celle du Cap Rhétée. Chacune d'elles
" forme une ligne ſemicirculaire, et elles ſe terminent, l'une et
" l'autre, dans la plaine, à la même diſtance de la mer que la
" nouvelle Ilium. Cette ville eſt, en effet, ſituée dans l'eſpace
" qui s'étend entre les extremités de ces collines, comme l'an-
" cienne Troye l'étoit entre leur origine. Elles comprennent
" dans leurs enceinte, la plaine du Simois, arroſée par ce fleuve,
" et celle du Scamandre. Ces deux parties forment un enſem-
" ble, qui eſt encore appelé la plaine de Troye, et qui fut,
" ſuivant le poëte, le théatre du plus grand nombre des combats.
" Le bois des figuiers ſauvages, le tombeau d'ÆSYETÈS, Batieia,
" le monument d'ILUS, le Scamandre, et le Simois, qui coulans
" l'un du côté du Cap Sigée, l'autre du côté du Cap Rhetée ſe
" réuniſſent, en face, et à une petite diſtance de la nouvelle
" Ilium, ſe jettent enſuite dans la mer près du Cap Sigée, et
" forment, avant de s'y jetter, un marais, appelé *Stoma Limné*,
" *le marais de l'embouchure* *."

JUSQU'ici

* Geograph. p. 892. Edit. Amſt. 1707.

JUSQU'ici STRABON n'auroit pas été plus exact quand il auroit eu la carte sous les yeux. La plaine où est située le village de Bounarbachi est, en effet, bordée de deux collines, à peu près semicirculaires, qui se dirigent, l'une vers le Sigée, et l'autre vers le Rhetée. On y retrouve encore aujourd'hui la plus grande partie des objets mentionnés par le poëte : La colline des figuiers sauvages, le tombeau d'ÆSYETÈS, le monument d'ILUS, le Scamandre, dont le cours est dirigé vers le Sigée, comme celui de Simois vers le Rhetée. Ces deux fleuves, qui se réunissoient autrefois, et alloient se jetter dans la mer près du Cap Sigée, en formant un marais qu'on voit encore aujourd'hui, à leur embouchure, ne se réunissent plus. Le Scamandre, comme on peut le remarquer dans la carte, suit une direction nouvelle. Les figuiers sauvages ne croissent plus dans les environs de Bounarbachi ; mais on en trouve par tout ailleurs, dans la plaine, et sur les montagnes voisines. Batieia, où le tombeau de MYRINNE, n'a point resisté aux injures du tems ; mais sa situation est une consequence evidente des objets connus qui l'environnoient.

" VIENT ensuite," continue STRABON, " la ville de Rhetée, " située sur une éminence, près de laquelle s'étend une plage sa- " blonneuse, où se trouve Aiantéum, c'est à dire, le tombeau " et le Temple d'AJAX, avec sa statue *."

L'ORIGINAL est encore ici un peu obscur et confus, mais autant qu'on y peut trouver un sens, il s'accorde en général avec la carte.

" LA longueur de la côte, qui s'étend entre le Cap Rhétée " et le Cap Sigée, où est le tombeau d'ACHILLE, est de *soixante* " *stades* en ligne droite ; elle se prolonge au dessous de la nou- " velle Ilium, dont la distance au port des Grecs est d'environ " douze stades †."

LA distance entre ces deux Caps, fixée géométriquement, est, à peu près, moindre de moitié que celle que STRABON donne ici ;

* P. 890.

† Ibidem.

ici ; mais parfaitement d'accord avec celle que PLINE le Naturaliſte aſſigne *. Quant à celle de la nouvelle Ilium au port des Grecs, ou à la mer, quel fond pouvons nous faire ſur l'exactitude de STRABON, qui d'abord la fixe à douze ſtades, et deux pages après la porte juſqu'à vingt ?

" UN peu au deſſus eſt ſitué le *village des Troyens*, où l'on
" croit qu'étoit autrefois l'ancienne Ilium, à la diſtance de
" trente ſtades de la nouvelle ; et dix ſtades au deſſus du village
" des Troyens, eſt la belle *Coloné*, eſpece d'éminence de cinq
" ſtades d'étendue, au pied de laquelle coule le Simois †."

IL y a encore ici quelques traits de reſſemblance, entre la deſcription de STRABON et notre carte ; mais après l'échantillon d'inexactitude que nous venons de remarquer dans ſes meſures précédentes, nous ſerons excuſables de ne pas faire plus de fonds ſur celles-ci. Les agréables collines qui s'étendent entre les villages de *Tchiblak* et *Aktché*, ſur les bords du Simois ſont néceſſairement la belle Coloné, de haut de laquelle MARS, ſemblable à une tempête, encourageoit les Troyens à grands cris ‡. STRABON les place à quarante ſtades au deſſus de la nouvelle Ilium, et nous apprend qu'elles s'étendoient à cinq ſtades le long des bords du Simois. A meſure, en effet, qu'on s'éloigne du village de Tchiblak, qui ſe trouve à peu près à quarante ſtades de l'ancienne Ilium, leurs ſommets couverts de gazon, perdent leur forme moëlleuſe et adoucie, et deviennent arides, rocailleux et eſcarpés. Quant au village des Troyens, *Ilienſium vicus*, qu'on croyoit occuper l'emplacement de l'ancienne Troye, STRABON ne put pas être ſoupçonné d'avoir voulu adopter cette croyance, puiſqu'il a commencé par dire, que l'ancienne Troye étoit à l'endroit d'où partent les deux collines ſemicirculaires.

" LA vallée de Thymbra n'eſt pas éloignée de l'ancienne
" Ilium ; elle eſt arroſée par le Thymbrius, qui ſe jette dans
" le

* Nat. Hiſt. lib. v. c. 33.

† P. 892. *ad finem.*

‡ Iliad. xx. 50.

" le Scamandre. Le temple d'APOLLON eſt ſitué ſur les bords " de ce premier fleuve*."

L'OUVERTURE de la vallée de Thymbra ſe trouvoit entre la nouvelle et l'ancienne Ilium. Elle étoit, quoique STRABON puiſſe ou veuille en dire, (car il n'eſt pas encore aiſé de la deviner ici), elle étoit, dis-je, plus voiſine de la première de ces villes que de la ſeconde. Le fleuve Thymbrius, après l'avoir arroſée, alloit autrefois ſe jetter dans les bras de la rivière formée par la réunion des deux fleuves, et que STRABON appelle Scamandre, ſans doute, parceque le Simois étant preſque toujours à ſec, on conſervoit aux deux fleuves réunis, le nom de celui qui portoit à la mer le tribut le plus conſtant de ſes eaux. L'embouchure du Thymbrius n'a point changé de place; mais le Simois ſeul reçoit ce fleuve, depuis que le Scamandre en eſt ſeparé. Les ruines du temple d'APOLLON ſe voyent encore, dans la vallée de Thymbra, ſur les bords du Thymbrius, près du village de Halil-eli.

" LE monument que l'on montre comme le tombeau d'ÆSYETÈS, eſt près de la route qui conduit d'Ilium recens à Alexdria Troas †."

ENVIRON un mille au deſſus d'Erkeſſighi, on voit encore ce grand tombeau. Il eſt en effet, près de la route qui conduiſoit autrefois de la nouvelle Ilium à Alexandria Troas. Il eſt même impoſſible, à cauſe des montagnes, d'aller de Bounar-bachi à Alexandrie, ſans paſſer près de ce monument, ainſi il ſe trouvoit également ſur la route de la nouvelle et de l'ancienne Troye à Alexandrie.

" CETTE partie de la plaine qui s'enfonce dans la montagne " eſt étroite; elle s'étend en partie vers le midi, juſqu'aux environs de Scepſis, en partie vers le nord juſqu'à *Zéléia*, ville " des Lyciens ‡."

ON

* STRABO, p. 893.

† P. 895.

‡ P. 891.

On reconnoit ici clairement ce vallon étroit, et bordé de précipices, où coule le Simois, et qui s'étend vers le ſud, depuis la plaine de Bounarbachi, dont il n'eſt qu'une continuation, juſqu'à celle d'Ené, voiſine d'*Eſki-kuptchu*, l'ancienne *Scepſis*: On voit auſſi, que cette ſeconde plaine, prend à Ené une direction qui s'éloigne du ſud; mais les bornes de la carte n'ont pas permis qu'on la repréſentât dans toute ſon étendue, c'eſt à dire, juſqu'au Cotylus, et à l'ancien pays des Lyciens, qui ſe trouvent, en effet, au nord.

La plaine de Troye n'a donc point changé de face depuis Strabon. J'étois ſuffiſamment autoriſé à placer l'ancienne Troye à l'origine des collines, et la nouvelle à leur extrémité; et ce géographe ne pouvoit m'accuſer d'infidélité, dans des poſitions auſſi clairement déſignées par lui-même. Des recherches particulières m'ont fait découvrir l'emplacement de ces deux villes; ainſi il ſera déſormais inutile de recourir avec Mr Wood aux tremblemens de terre, dont rien n'offre la trace dans la plaine de Troye, et dont tout, au contraire, démontre la fauſſeté, pour expliquer la diſparition, ou la deſtruction des monumens, des fleuves, et des vallées, qu'on retrouve encore dans le lieu même où Homere les a vus, et où Strabon n'auroit pas manqué de les trouver lui-même, ſi, au lieu de s'en rapporter à l'autorité de Demetrius de Scepſis, il avoit pris la peine de ſe tranſporter dans la Troade.

Il eſt ſurprenant que le Docteur Chandler ait cru néceſſaire d'informer ſon lecteur, que le Simois avoit été confondu avec le Scamandre, et ſoit, en même tems, tombé dans l'erreur qu'il cherche à corriger, en avançant, que le Simois étoit la rivière la plus voiſine du Cap Sigée et du Lectos, tandis qu'il auroit du dire cela du Scamandre.

Homere, plus exact que tous les voyageurs qui l'ont ſuivi dans la plaine de Troye, indique la ſituation relative du Scamandre, avec la plus grande préciſion et la plus grande exactitude, quand il dit:

—ὅδε

To face page 49 Lat. Cl.

Carte de la Plaine de Troye, par Pope. | Mr. Pope's. Map of the Plain of Troy.

Troja cum Locis pertingentibus. 1. Porta Scæa & Fagus. 2. Caprificus. 3. Fontes Scamandri duo. 4. Callicolone prope Simoin. 5. Batieia seu Sepulcrum Myrinnes. 6. Ili Monimentum. 7. Tumulus Æsyetis. A. A. Murus Achivorum. B. Locus Pugnæ ante naves in lib. 8. 12. 13. 14. C. Gesta Diomedis hoc loco lib. 5. D. Achillis & Scamandri Certatio lib. 22. E. Locus Pugnæ in lib. 6. F. Pugnæ in lib. 11. G. Pugnæ in lib. 20.

——— ὐδέ πω Ἕκτωρ
Πεύθετ᾽· ἐπεί ῥα μάχης ἐπ᾽ ἀριστερὰ μάρνατο πάσης.
Ὄχθας πὰρ ποταμοῖο Σκαμάνδρου· ——— *

" Et HECTOR ne ſavoit pas ce qui ſe paſſoit, parcequ'il com-
" battoit à la gauche de l'armée (des Troyens), ſur les rives du
" Scamandre."

CHAP. IX.

Examen de la carte de la Plaine de Troye par Pope.

LA critique amère que Mr WOOD fait de la carte, qu'on voit à la tête de la traduction de l'Iliade, par le célèbre POPE, m'a inſpiré la curioſité d'examiner cette carte, et de la comparer avec la mienne †. A la ſeule manière dont elle eſt déſignée, il eſt aiſé de juger, qu'elle n'eſt pas l'ouvrage d'un géographe; car les objets n'y ſont pas repréſentés ſuivant la convention à vol d'oiſeau, mais en perſpective, comme dans un tableau de payſage. Cette faute eſt de peu de conſéquence aux yeux des litterateurs, et je pardonnerois à POPE lui-même de l'avoir commiſe, pourvuque ſon mauvais deſſin fut exact, et qu'on put y appliquer les différentes circonſtances de la guerre de Troye, dont il donne la deſcription la plus complette, et la plus détaillée; mais cette carte offre des erreurs ſi extraordinaires, que j'ai d'abord été tenté de croire, qu'elles ne pouvoient provenir que de la mal-adreſſe du graveur, qui a tranſ-

* Iliad. xi. 497.

† Voyez An Eſſay on the original Genius and Writings of HOMER, p. 87.

porté ſur la droite les objets deſtinés à occuper la gauche. En effet, comment put-on ſuppoſer que POPE ait placé le Cap Sigée à la gauche du camp des Grecs ?

LES erreurs au ſujet du tombeau d'ÆSYETÈS, et de celui d'ILUS ſont moins choquantes, et plus pardonnables que la précédente. Il a placé le premier de ces tombeaux entre les deux fleuves, ſur la rive gauche du Scamandre, tandis qu'il ſe trouve ſur la droite ; mais le poëte s'étoit contenté d'indiquer ce tombeau comme l'endroit le plus avantageux que POLITÈS, fils de PRIAM, put choiſir pour obſerver les mouvemens des Grecs *; il n'avoit pas porté le ſcrupule juſqu'à déſigner le point mathématique où il étoit ſitué.

QUANT à la poſition du tombeau d'ILUS, POPE a evidemment mal compris le ſens d'HOMERE, en la plaçant à moitié chemin du camp des Grecs et de la ville de Troye ; ce n'eſt pas là ce qu'HOMERE a voulu dire, en nous apprenant, que le tombeau d'ILUS *étoit au milieu de la plaine :* STRABON nous explique ſa penſée, quand il nous dit, qu'ILUS fut enterré au *milieu de la plaine, parce qu'il avoit oſé l'habiter le premier* †.

DU reſte, il a parfaitement deviné la ſituation du camp des Grecs, entre les deux caps ; la réunion des deux fleuves, à peu de diſtance des vaiſſeaux ; la forme générale de la plaine ; le cours du Simois, plus étendu que celui du Scamandre ; la juſte diſtance de la ville à la mer ; le voiſinage de la même ville, et des deux ſources du Scamandre : Mais quel motif peut l'avoir déterminé à les placer du côté oppoſé à celui où elles ſe trouvent dans la nature ? J'y ai réfléchi long tems, et avec d'autant plus d'intérêt, que parmi tous les auteurs qui ont écrit ſur la Troade, il en eſt peu qui m'en impoſe plus que POPE.

NE pourroit-on pas ſuppoſer, que ce grand homme, ayant découvert dans quelque paſſage de l'Iliade, que les ſources du Scamandre étoient au couchant ; accoutumé d'ailleurs à regarder, ſuivant l'uſage reçu, la gauche d'une carte comme le couchant, ait,

* Iliad. ii. 791.

† STRABO, p. 886. Edit. Amſt. 1707.

ait, à défaut de connoître les petites reſſources de la géographie, ſacrifié toutes ſes autres poſitions, telles que celles du Cap Sigée, du Simois, &c. à l'impérieuſe loi d'être fidel à ſon original? C'eſt ainſi, ſi l'on me pardonne de ſuppoſer qu'un très grand poëte puiſſe être un médiocre géographe, c'eſt ainſi dis-je, qu'il faut rendre compte des défauts de cette carte, qui, avec toutes ſes imperfections, a dû coûter à POPE, infiniment de peine, et exiger de ſa part de grandes combinaiſons. Je ne vois, du moins, que ce moyen, d'expliquer comment le même homme peut produire une carte auſſi défectueuſe, à l'appui de l'eſſai le plus complet, et le plus exact, ſur les batailles d'HOMERE.

J'AI été tellement enchanté, Meſſieurs, de la préciſion avec laquelle cet eſſai s'accorde avec ma carte, que j'ai cru devoir le mettre ſous vos yeux, à fin d'augmenter votre confiance dans mes travaux, par une autorité d'un grand poids parmi vous, et dans le reſte du monde ſavant.

" L'ANCIENNE ville de Troye étoit," dit il *, " à une plus
" grande diſtance de la mer que les ruines d'Alexandria Troas,
" qu'on a mal-à-propos confondues avec les ſiennes. Les
" Troyens, en effet, n'oſerent combattre hors de leurs murailles,
" qu'après la retraite d'ACHILLE ; mais dans la ſuite ils atta-
" querent les Grecs, juſqu'auprès de leurs vaiſſeaux, très éloig-
" nés de la ville. D'ailleurs, comme obſerve STRABON, ſi cette
" ville avoit été voiſine du rivage, il y auroit eu de la folie, et
" de l'imprudence de la part des Grecs, à attendre la dixième
" année du ſiège, pour fortifier leur camp, contre un ennemi
" qui les auroit menacés de ſi près ; et il y auroit eu de la
" lâcheté de la part des Troyens, à reſter ſi long tems dans l'in-
" action, et à rien tenter contre une armée ſans retranchemens †.
" De plus, dans la ſuppoſition où la ville eut été près du rivage,

* Voyez l'Eſſai au commencement du liv. v. de ſa traduction de l'Iliade.

† STRABO, p. 893. Edit. Amſt. 1707.

" l'eſpace intermédiaire n'auroit pas été ſuffiſant pour les com-
" bats, et les événemens dont il a été le théatre.

" LES lieux les plus remarquables autour de Troye," continue toujours POPE, " étoient : 1. Les *portes Scées.* Elles " s'ouvroient ſur le champ de bataille, et c'étoit par là que " ſortoient les Troyens, lorſqu'ils alloient au combat. Tout " près de ces portes étoit le *chêne*, *conſacré à Jupiter*. 2. La " colline des *figuiers ſauvages*, ou l'*Erineos*. Elle étoit ad- " jacente aux murailles de la ville, puiſqu' ANDROMAQUE " cherche à diriger l'attention d'HECTOR du côté de cette " colline, comme étant le ſeul endroit par où l'ennemi pouvoit " eſcalader la ville *. Il paroit qu'elle s'étendoit juſqu'au grand " chemin ; car dans la courſe d'HECTOR et d'ACHILLE, ces " deux guerriers, après avoir paſſé la colline des figuiers, parvi- " ennent à la grande route †. 3. Les *deux ſources du Scaman-* " *dre*, étoient un peu plus loin, ſur la même direction ‡." En effet, les deux guerriers après avoir traverſé la colline des figuiers, et la route publique, s'arrêtent près de ces ſources. " 4. *Callicoloné* étoit le nom d'une agréable colline, qui s'étendoit " ſur le bords du Simois de l'autre côté de la ville ‖. 5. *Batieia*, " où le tombeau de MYRINNE, étoit en face de la ville, à peu " de diſtance §. 6. Le monument d'ILUS, vers le milieu de la " plaine **."

POPE, après nous avoir fait connoître la ſituation des principaux objets qui avoiſinoient la ville, et qui étoient ſitués dans la plaine, nous trace celle des différens champs de bataille.

" IL paroit," dit-il, " par le quatre-cens ſoixante-ſeptième " vers du ſecond livre de l'Iliade, que l'armée Greque, ſous la " conduite de différens chefs, étoit rangée ſur les rives du Sca- " mandre, du côté des vaiſſeaux ; pendant que celle de Troye et " des

* Iliad. vi. 432.
† Ibid. xxii. 145.
‡ Ibid. xxii. 147.
‖ Iliad. xx. 53.
§ Ibid. ii. 813.
** Ibid. xi. 166.

" des auxiliaires, étoit vers le tombeau de MYRINNE *. Le " premier champ de bataille, où DIOMÈDE fit de ſi grands ex- " ploits, étoit près de la réunion du Simois et du Scamandre ; " car JUNON et PALLAS venant à lui, deſcendent au confluent " des ces deux rivieres †. Les Grecs, alors, n'avoient pas en- " core paſſé le Scamandre, puiſque JUNON dit, que *les Troyens* " *les bravent juſques près de leurs vaiſſeaux* ‡. Mais au com- " mencement du ſixième livre, les batailles ſe donnent entre " les rives du Simois et du Scamandre.

" ON ſe bat dans le huitième livre, près des retranchemens " des Grecs ſur le rivage de la mer ; et dans l'onzième livre, " aux environs du tombeau d'ILUS : Dans le douzième, le trei- " zième et quatorzième, près du retranchement des Grecs ; et " dans le quinzième, aux vaiſſeaux.

" DANS le ſeizième, les Troyens étant repouſſés par PATRO- " CLE, le combat s'engage entre la flotte, la rivière, et les " hautes murailles des Grecs ‖. Dans le même livre, PATRO- " CLE s'avançant de plus en plus, va combattre juſqu'aux " portes de Troye §. Dans le dix-ſeptième, on ſe diſpute le " corps de PATROCLE ſous les murailles de Troye **. Dans le " même livre, HECTOR et ENÉE pourſuivent, juſques dans " leurs retranchemens, les Grecs, qui emportent le corps de " PATROCLE ††. Dans le dix-huitième, ACHILLE, venant à " paroître, les Troyens ſe retirent, et placent leur camp en " dehors des fortifications.

" DANS le vingtième, on combattoit encore près de la mer ; " puiſque les Troyens pourſuivis par ACHILLE, traverſent le " Scamandre, en fuyant vers leur ville ‡‡."

POPE paroit ſurpris de ce qu'HOMERE n'ait point exprimé de quelle manière les armées paſſoient le fleuve. La raiſon de

ſon

* Iliad. ii. 815.

† Ibid. v. 773.

‡ Ibid. 791.

‖ Ibid. xvi. 396.

§ Iliad. xvi. 700.

** Ibid. xvii. 403.

†† Ibid. xvii. 760.

‡‡ Ibid. xx. 1.

ſon ſilence, à cet égard, eſt bien ſimple ; c'eſt que le Scamandre eſt un ruiſſeau, qui a tout-au-plus, quinze pieds de large, et trois pieds de profondeur. Il auroit du ſoupçonner cette raiſon, puiſqu'il a très bien remarqué lui-même, que les batailles ſuivantes ſe donnoient *dans le fleuve*, ou ſous les murs de la ville. Comment auroit-on pu ſe battre dans un fleuve qui auroit eu quelque profondeur ?

C H A P. X.

Examen de la même carte par Mr Wood.

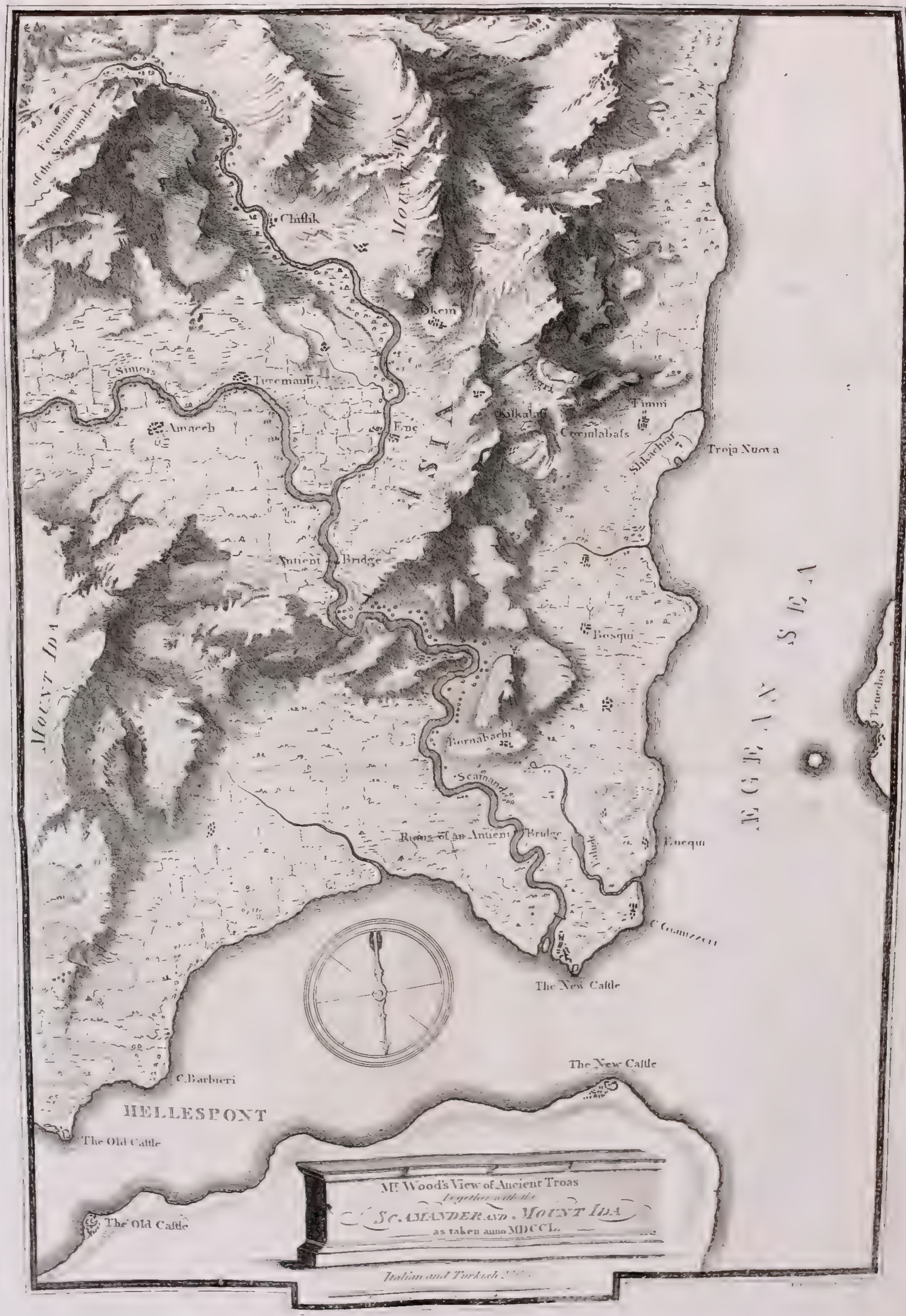
LA certitude de notre propre ſupériorité, peut nous porter à négliger l'opinion et les travaux des autres. Ce ſentiment, quoique peu modeſte, provoque l'indulgence, quand il eſt couronné de ſuccès ; mais quand, au mépris des guides, on vient à s'égarer, on perd dès lors tous les droits à la compaſſion, et l'on mérite toute la ſévérité de la critique.

Je ne crains pas de le dire, Meſſieurs, parce que je vais le prouver, Mr Wood a mal vu la Troade. Cette partie de ſon eſſai ſur Homere, n'eſt pas ſeulement imparfaite, elle eſt décidémment mauvaiſe. Il n'eſt pas étonnant, au reſte, qu'ayant pour but principal, de nous faire connoître les intéreſſantes ruines de Palmyre, et de Balbec, il n'ait pas pu donner à la plaine de Troye, le tems, et l'attention qu'elle méritoit. Ce n'étoit pas un crime à Mr Wood à l'omettre, mais c'en eſt un véritable, d'avoir mieux aimé la boulverſer, que de l'étudier avec l'ouvrage de Pococke à la main.

Suivons

Mr. Wood's View of Ancient Troas
Together with the
SCAMANDER AND MOUNT IDA
as taken anno MDCCL.
Italian and Turkish Miles
1
2
3
4
HELLESPONT
The Old Castle
The Old Castle
C. Barbieri
The New Castle
The New Castle
C. Gianizzeri
Ruins of an Antient Bridge
Palude

To face page 54. L.Ed.



Suivons cet homme célèbre. Vous allez être étonnés, Messieurs, de la peine qu'il se donne, pour découvrir la situation de l'ancienne Troye, et les sources du Scamandre, à plus de quinze lieues de la mer ; vous serez étonnés, qu'il ait vu le Scamandre *, qu'il l'ait dessiné sur sa carte, sans le reconnoître ; vous serez étonnés, qu'il ne fasse aucune mention de ces monumens extraordinaires, qui avoient au moins fixé l'attention de Pococke ; vous serez étonnés, de ne pas trouver une seule fois le nom de ce voyageur dans sa bouche.

" Si l'on examine ma carte de la Troade," dit Mr Wood, " on ne la trouvera pas d'accord avec le pays que décrit Homere †." Tant pis. Comment se fait-il que vous ayez trouvé ce grand poëte partout d'accord avec la nature, et que vous le trouviez justement en faute, dans les lieux qu'il a du observer, et dépeindre avec le plus de soin ?

" Cette différence," continue Mr Wood, " vient d'un accroissement de terrein qui a augmenté la distance de Troye, à la mer ‡." Mais, de grace, Mr Wood, quelle preuve avez-vous, que la Troade s'est élargie de dix lieues ? Car il n'en faut pas moins, pour vous autoriser à placer la ville de Troye aux sources de ce torrent que vous appellez votre Scamandre.

Dans quelle partie de la Troade s'est fait cet accroissement, et quelle en a été la cause ? Est-ce le Simois qui a allongé la plaine, à force de charier des sables à son embouchure ? Il est aisé de mesurer la petite augmentation, qui en a résulté pour la plaine de Troye, entre les deux caps. Il est aisé même, de prouver, que cette augmentation ne put pas devenir plus considerable, parceque les impétueux courans de l'Hellespont s'y opposent sans cesse, et entrainent les sables dans la mer Egée, à mesure que le fleuve les accumule à son embouchure.

Ce

* Description of the Troade, p. 326.

† Ibid. p. 328.

‡ Ibid. p. 320.

Ce n'eſt donc pas à l'embouchure du Simois que l'accroiſſement de la Troade peut avoir eu lieu ; mais dans quel endroit de la côte s'eſt-il donc fait ? Les ruines d'Alexandrie ſe voient encore dans le lieu même où cette ville étoit autrefois ſituée. Le haut promontoire de Sigée, forme encore avec la pointe de la cherſoneſe l'entrée de l'Helleſpont, comme au tems d'Achille et d'Homere. Encore une fois, où s'eſt donc operé cette prodigieuſe révolution que Mr Wood appelle à ſon ſécours ?

" Je ſuis pareillement très ſûr," dit enſuite Mr Wood, " que la ſituation du Scamandre eſt conſidérablement changée ; " et ce qui fond mon opinion à cet égard, c'eſt que cette ri- " vière avoit une ſource chaude ; mais cette ſource eſt beaucoup " plus bas que celle que nous avons découverte, et n'a point de " communication avec le Scamandre."

Il ne faut que jetter un coup d'oeil ſur la carte de Mr Wood, pour appercevoir, que c'eſt un ouvrage negligé, et fait à la hâte. On n'y voit ni villages, ni routes, ni monumens. Lorſque Mr Wood parle d'une ſource chaude *inferieure*, ce n'eſt pas de celle de Bounarbachi dont il prétend parler, puiſqu'il ne l'a pas connue, c'eſt ſans doute des ſources thermales de Lidja, près d'Alexandrie *. En un mot, et pour ne point prolonger une critique inutile, à laquelle Mr Wood donne lieu dans tout le cours de ſa deſcription, voici, je penſe, comment il a procédé dans ſes obſervations, et comment il a été entrainé dans ſes erreurs :

Persuadé que le Simois ſe réuniſſoit au Scamandre, il a ſuivi le cours de ce premier fleuve, et il n'a rien trouvé juſqu'à Bounarbachi où la plaine ſe termine ; parceque le Scamandre avoit déjà, ſans doute, été detourné de ſon ancien lit, et que Mr Wood n'aura pas été aſſez heureux pour appercevoir ce changement particulier, qui a été la véritable cauſe de mes principales découvertes.

Il a vu les ſources de Bounarbachi ; mais ſoit qu'il les ait obſervées légèrement, ſoit qu'il les ait vues dans une ſaiſon, où il

* Voyez ci-devant, p. 8.

il y avoit peu de différence dans leur temperature, ſoit qu'il ait ignoré la langue Turque et Grecque, ou qu'il n'ait pu tirer aucun renſeignement de l'Aga, et des habitans du village voiſin, le fait eſt, qu'il n'a pas reconnu les véritables ſources du Scamandre.

Du moment où il a été hors de la plaine, et qu'il s'eſt enfoncé dans les défilés et les montagnes de l'Ida, ſon erreur eſt devenue ſans remède : Plus il s'eſt éloigné de la mer, plus les deſcriptions d'Homere ſont devenues inexplicables pour lui. Tout autre à ſa place, ou plus modeſte, ou moins entêté, ſeroit revenu ſur ſes pas, ou, dumoins, auroit abandonné la partie, en convenant qu'il n'avoit pas réuſſi. Mr Wood eſt intrépide: Les difficultés rehauſſent ſon courage : Il s'avance juſqu'à ce qu'il trouve un large torrent, qui à travers des montagnes impraticables vient ſe joindre au Simois près d'Iné. Voilà le Scamandre de Mr Wood !

Il faut maintenant aller chercher la ville de Troye, juſqu'aux ſources de ce torrent; Mr Wood ne perd pas courage; il voit clairement qu'il eſt égaré, mais il ne veut pas ſortir de la Troade ſans l'avoir boulverſée. Il cherche un compagnon d'infortune, il le trouve dans Strabon, qui à la vérité s'eſt trompé comme lui; mais ne s'eſt pas trompé ſur les lieux, comme il l'en accuſe; car tout le monde ſait, et Mr Wood ne devroit pas l'ignoré, que ce géographe n'a parlé de la Troade que ſur l'autorité de Demetrius de Scepſis.

Après avoir invoqué les tremblemens de terre, les convulſions de la nature; après avoir extravagué ſur la ſituation de l'ancienne Troye, et avoir fait même une deſcription riante de la ſource de ce hideux torrent, qui baigne les murs d'Iné; après l'avoir complaiſamment enrichie d'une joli baſin, d'un beau platane, et d'un bois romantique; après avoir retrouvé dans ce torrent tous les caractères du Scamandre, il finit, par conclure, " que d'après l'autorité de l'hiſtoire, il faut rogner de

" plusieurs milles la nouvelle carte de Troye pour retrouver l'an-
" cienne *."

On voit par ces derniers mots, que Mr Wood déchiroit les cartes, avec autant de facilité qu'il les faisoit; mais la Nature ne se laisse pas ainsi mutiler; et quand on annonce ses révolutions pour appuyer un systême, il faut y être autorisé par des faits historiques, bien prouvés, ou par quelques traces subsistantes des désordres passés.

CHAP. XI.

Comparaison du Scamandre et du Simois.

Les sources du Scamandre, sortent de la terre avec une rapidité, qui annonce qu'elles descendent d'un lieu très élevé. Le fleuve qu'elles forment, conserve cette rapidité remarquable, jusqu'à l'endroit où il entre dans son nouveau canal artificiel. Les fréquents tourbillons, que l'on voit se former à sa surface, et qui sont occasionnés par le violent choc de ses eaux contre les nombreuses sinuosités qui leur sont opposées, sont, peut-être, ce qui à engagé le poëte à lui donner l'épithète, de *δινήεις* †.

Jamais

* Description of the Troade, p. 330.

† Ἀλλ' ὅτε δὴ πόρον ἷξον ἐϋῤῥεῖος ποταμοῖο
Ξάνθου ΔΙΝΗΕΝΤΟΣ—— Iliad. xxi. 1.

—————— ἀλλὰ Σκάμανδρος
Οἴσει ΔΙΝΗΕΙΣ—— Ibid. 124. et alibi passim.

JAMAIS ce fleuve n'augmente ni ne diminue. Les eaux ſont claires et limpides comme le criſtal *. Les rives ſont couvertes des fleurs †. Les mêmes arbres et les mêmes plantes qui croiſſoient ſur ſes bords, lorſqu'il combattoit VULCAIN, y croiſſent encore aujourd'hui; on y voit *des ſaules, des lotos, des ormes, et des joncs; et l'on y pêche encore des anguilles* ‡.

MAIS, ſi le grand HOMERE eſt d'une exactitude frappante dans les épithetes, et dans les attributs particuliers qu'il donne au Scamandre, il n'eſt pas moins admirable, dans la comparaiſon qu'il fait de ce fleuve avec le Simois. Il les characteriſe tous deux d'une manière parfaitement analogue à la nature, et à leur état actuel.

LORSQUE le Scamandre, combattant ACHILLE, craint d'être vaincu par ce guerrier, il appelle le Simois à ſon ſécours: "Réunifſez-vous à moi," lui dit-il, "mon frere, pour terraſſer "ce vaillant guerrier; raſſemblez toutes vos eaux; *déracinez les "arbres, et entrainez les rochers* ‖.

HOMERE ne pouvoit pas peindre avec plus de vérité, la foibleſſe du Scamandre, et les ravages du Simois; mais il n'eſt pas encore content de ſon tableau, il veut nous faire connoître la largeur du Scamandre.

h 2 ACHILLE,

* ——— 'ΕΥΡΡΕΙΟΣ ποταμοῖο—uti jam citat.
——— σχέτο δ' ἀγλαὸν ὕδωρ. Iliad. xxi. 345.

† Ἔσταν ἐν λειμῶνι Σκαμανδρίῳ ἈΝΘΕΜΟΕΝΤΙ
Μυρίοι——— Ibid. ii. 467.

‡ Καίοντο πτελέαι τε, καὶ ἰτέαι, ἠδὲ μυρῖκαι,
Καίετο δὲ λωτός τ', ἠδὲ θρύον, ἠδὲ κύπειρον,
Τὰ περὶ καλὰ ῥέεθρα ἅλις ποταμοῖο πεφύκει·
Τεῖροντ' ἐγχελύες τε, καὶ ἰχθύες,——— Ibid. xxi. 350.

‖ Φίλε κασίγνητε, &c. Ibid. xxi. 308.

" Achille, ſur le point de ſuccomber lui-même, arrache un " orme qui croiſſoit ſur les rives du Scamandre, il le renverſe " d'un bord à l'autre, et en forme un pont, ſur lequel il échappe " à la fureur du fleuve *."

CHAP. XII.

Tombeau d'Æſyetès.

" LA Baſſe Egypte," dit Mr Bryant †, " étant un pays " plat, et ſujet à de frequentes inondations, ſes habitans " étoient forcés, d'élever le terrein ſur lequel ils bâtiſſoient leurs " édifices. Pluſieurs de leurs tours ſacrées étoient de hauts " monticules de forme conique : On voyoit auſſi dans beaucoup " d'endroits des éminences, ſur leſquelles il n'y avoit point " d'édifice, et qui étoient deſtinées pour les cérémonies de la " religion. On les appeloit dans certains lieux, *Taph :* Comme " Taph-hanes, Taph-Oſiris, et dans d'autres Taphiouſa, Taphitis, " Tapé.

" Mais comme c'étoit auſſi, l'uſage, d'enterrer les perſon-" nes de diſtinction, ſous des monceaux de terre de la même " forme, toutes les éminences conſacrées de la religion, furent " regardées comme les monumens des héros ; et les Grecs, ſur-" tout, en avoient tous cette opinion. Ils prétendoient mon-" trer

* ———— ὁ δὲ πτέλεην ἕλε χερσὶν Εὐφυέα, μεγάλην· &c. Ibid. xxi. 242.

† New Syſtem of Mythology, vol. i. p. 449.

" trer le tombeau de BACCHUS, à Delphes ; celui de JUPITER,
" en Crete."

Mr BRYANT cherche à prouver ici, que les Grecs étoient dans l'erreur, en confondant les monticules ſacrés avec les tombeaux des héros ; mais HOMERE, et toute l'antiquité, s'accordent à nous convaincre, qu'on n'avoit pas d'autre manière de conſerver leurs cendres, qu'en les dépoſant ſous ces éminences. On en trouve de la même forme, et de la même eſpace dans tous les pays ; et partout où on prend la peine de les fouiller, on y trouve toujours quelques débris du corps humain. Il pouvoit y avoir quelques unes d'elles particulièrement conſacrées aux cérémonies de la religion ; mais on ne peut pas nier, que le plus grand nombre étoit deſtiné à renfermer les cendres des héros, et de grands perſonnages.

IL eſt bien extraordinaire, que les Turcs leur ayent conſervé le même nom que leur donnoient les Egyptiens. Cette tradition, que j'ai étudiée avec ſoin, n'a point été, comme beaucoup d'autres, tranſmiſe par les Grecs à leurs conquérans. Les Turcs qui habitent le fond de l'Aſie, et les montagnes du Caucaſe, ceux-là qui n'ont jamais eu de communication avec les Grecs, employent le même nom pour déſigner cette eſpèce de monumens, et ils ne peuvent l'avoir reçu que des Arabes.

JE ne balance donc point à croire, que le monticule ſitué près d'Udjek, et qu'ils appelent Udjek-TAPÉ, ne ſoit un tombeau. Et tout m'engage à penſer que c'eſt celui d'ÆSYETÈS, monument de la plus haute antiquité, puiſqu'il ſubſiſtoit déjà avant la guerre de Troye.

CE tombeau, ſuivant HOMERE, étoit très élevé, c'eſt dumoins l'épithete qu'il lui donne : " POLITÈS, fils de PRIAM, ſe fiant " ſur ſon agilité, alloit de la ville ſe placer ſur le ſommet de ce " tombeau, pour obſerver les mouvemens de l'armée Greque *." Il ne pouvoit pas, en effet, choiſir une ſituation plus avantageuſe pour diſtinguer dans ſon entier l'eſpace compris entre les deux

caps.

* Iliad. ii 791.

caps. Il falloit auſſi, qu'il eut une grande confiance dans ſon agilité, car il ſe trouvoit alors fort éloigné de la ville.

Ce que Strabon écrit relativement à la ſituation de la vieille et de la nouvelle Ilium, contribue merveilleuſement à déterminer la poſition du tombeau d'Æsyetès. Il prouve, avec le ſecours de Demetrius, que la vieille Ilium, étoit beaucoup plus éloignée de la mer que la nouvelle : Ὅ τε Πολίτης—

> Ὃς Τρώων σκοπὸς ἷζε ποδωκείῃσι πεποιθὼς
> Τύμβῳ ἐπ' ἀκροτάτῳ Αἰσυήταο γέροντος *,

μάταιος ἦν· κ. τ. λ. " Et en ſuppoſant," dit-il, " que la vieille " et la nouvelle Ilium fuſſent la même ville, Politès auroit " fait une folie, ſi en qualité d'eſpion Troyen, et ſe fiant ſur ſon " agilité, il avoit été ſe placer ſur le monument d'Æsyetès, " (pour obſerver les mouvemens des Grecs) ; car en accordant " qu'il étoit alors ſur un lieu très élevé, il faut convenir que " l'acropolis, ou la citadelle de Troye, l'étoit encore davantage ; " qu'elle étoit, à peu près, à la même diſtance, et qu'il n'au- " roit pas eu beſoin alors de recourir à ſon agilité, puiſque le " monument qu'on montre aujourd'hui comme le tombeau " d'Æsyetès eſt à cinq ſtades de diſtance, et près de la route " qui conduit à Alexandrie †."

Nous pouvons ajouter, que la même raiſon qui eut fait accuſer Politès de folie, pour aller ſur la tombe d'Æsyetès reconnoître l'ennemi, ſi l'ancienne Troye avoit été ſituée où étoit la nouvelle, le rend très excuſable, dans la ſuppoſition, où l'ancienne étoit au fond de la plaine ; car alors, il lui avoit été impoſſible d'appercevoir le cap Rhetée du ſommet de l'acropolis, où de la citadelle, puiſque les collines qui s'avancent dans la plaine, du côté du nord, l'auroient entièrement dérobé à ſa vue.

CHAP.

* Iliad. ii. 792.

† Strabo, p. 894.

CHAP. XIII.

Situation du Camp des Grecs.

LES anciens Grecs avoient coutume, et cette coutume s'eſt encore conſervée parmi les modernes, de tirer leurs vaiſſeaux à ſec, ſur le rivage, lorſqu'ils devoient faire quelque ſéjour dans les lieux où ils abordoient. La flotte d'AGAMEMNON, compoſée de mille vaiſſeaux, ne pouvant pas trouver place ſur une ſeule ligne, dans l'eſpace compris entre le cap Sigée et le cap Rhetée, on fut obligé de les diſpoſer ſur deux rangs, en forme d'échelle, en ſorte que ceux des vaiſſeaux qui avoient abordé les premiers, étoient plus avancés vers la plaine, et les dernièrs reſtoient plus voiſins du rivage de la mer. Entre les deux rangs des vaiſſeaux, on avoit placé les tentes, les ſtatues des dieux, et le ſiège du conſeil *. La tente du Général occupoit le milieu du camp. ACHILLE étoit à l'aile droite, au cap Sigée, et AJAX à la gauche, au cap Rhetée. HOMERE nous donne, lui-même, la diſpoſition de ce camp, dans le quatorzième livre de l'Iliade †.

Mr d'ANVILLE et Mr WOOD ‡, s'accordent tous deux, à placer le cap Rhetée à *la pointe de Berbier*, qui ſe trouve à plus de ſix milles du cap de Jeni-chehr, ou du cap Sigée. A coup ſûr, ſi les mille vaiſſeaux, ou plutôt les mille bateaux, d'AGAMEMNON, avoient eu un auſſi grand eſpace pour ſe mettre en bataille, ils n'auroient pas eu beſoin de doubler les rangs.

Je

* Iliad. xi. 805. † Ibid. xiv. 30.

‡ Vid. Deſcription of the Troade, p. 317. Mem. de l'Acad. des Inſcrip. tom. xxviii. p. 318.

Je pardonne cette erreur à Mr d'Anville, qui n'étoit jamais ſorté de Paris, et qui n'en étoit pas moins l'un des meilleurs géographes de l'Europe ; mais Mr Wood me paroît d'autant plus criminel, et plus impardonnable encore, que le Dr Pococke lui avoit tracé la route du tombeau d'Ajax, et que c'eſt à cet excellent voyageur que j'en dois la découverte moi-même.

" Vers l'oueſt du village de It-guelmes," dit Pococke, " j'apperçus une pointe de montagne, que je ſuppoſai être " l'*Aiantéum*, où étoit le tombeau d'Ajax, et ſa ſtatue. En de-" ſcendant la plaine de Troye, j'obſervai un monticule, ſur " lequel il y avoit encore des débris de marbre, mais je n'oſe " pas décider ſi c'eſt-là le tombeau d'Ajax ou non *." Trop modeſte Pococke ! quel motif a pu vous rendre auſſi timide dans vos jugemens ſur les tombeaux de la Troade ? Avez-vous jamais appris que les nations modernes ayent élevés de pareils monumens à la mémoire de leurs guerriers ? Ne ſaviez-vous pas, que la forme, et la ſtructure, de ces tombeaux étoient adoptées par les plus anciens peuples du monde ? Pourquoi votre exceſſive modeſtie nous condamne-t-elle à paroître téméraire en avançant comme certain, ce que vous n'avez regardé que comme douteux ?

Du moment que Mr Wood a trouvé, que la diſtance entre le cap Jeni-chehr et la pointe des Berbiers, (qu'il a confondu avec le cap Rhetée), étoit de douze milles, il n'eſt pas étonnant, qu'il ait accuſé le poëte d'exageration, quand il nous repréſente Agamemnon faiſant entendre ſa voix juſqu'au vaiſſeau d'Ulysse, qui étoit au centre de l'armée †.

Au reſte, il eſt probable, que c'eſt Strabon lui-même qui a égaré Mr Wood et Mr d'Anville, en aſſurant que la diſtance du Cap Sigée au Cap Rhetée étoit de ſoixante ſtades ‡.

J'ai

* Deſcription of the Eaſt, &c. vol. ii. part ii. p. 104, 105.

† Deſcription of the Troade, p. 336. Iliad. viii. 220.

‡ Strabo, p. 890: Edit. Amſt. 1707.

J'AI fixé géometriquement cette diſtance, et je l'ai trouvée de trois mille toiſes, meſure qui ſe trouve parfaitement d'accord avec celle de trente ſtades, que PLINE nous a laiſſée *.

EN conſidérant les marais qui occupent, maintenant, une partie de l'eſpace compris entre les deux caps, et qui l'occupoient de même au tems de STRABON; en reflechiſſant, d'ailleurs ſur les inondations du Simois, on a peine à comprendre que les Grecs aient aſſis leur camp ſur un terrein auſſi déſavantageux, et particulièrement, qu'ils aient pu s'y maintenir pendant dix ans.

MAIS quoique la guerre ait duré pendant ce long intervalle, il ne paroît pas, même d'après HOMERE, que les Grecs ſoient reſtés, tout ce tems, campés entre le Sigée et le Rhetée. On convient généralement qu'ils ne déployerent tous leurs efforts contre la ville, que pendant le printems et l'été de la dernière année; et qu'ils ne firent juſqu'alors que ravager les pays voiſins, à deſſein d'affoiblir leurs ennemis, de diminuer et d'intercepter leurs reſſources, et d'oter, enfin, tout moyen de defenſe à cette ville, qu'ils avoient d'abord regardée comme imprenable. Dans le cours de cette guerre, les Grecs, ſans doute, devoient tranſporter leurs vaiſſeaux d'un lieu à un autre, ſelon qu'ils le trouvoient plus convenable à leurs opérations, et à leur ſûreté; et il y a même quelques raiſons de conclure, de certains paſſages de l'Iliade, que lorſqu'ils entreprenoient une expédition dans les pays voiſins, ils diviſoient leurs forces en pluſieurs détachemens, qui, ſous la conduite de leurs chefs reſpectifs, retournoient au rendez-vous commun avec le butin qu'ils avoient fait ſur l'ennemi.

ENFIN, à la dixième année il eſt probable, qu'ils camperent avec l'enſemble de leurs forces à l'embouchure du Scamandre, pendant l'été, ſaiſon où le Simois étoit continuellement à ſec, excepté après des pluies accidentelles et de courte durée; et qu'ils reſolurent alors, de porter un coup déciſif à leur ennemi. Dans cette ſituation, et ſans doute, bientôt après qu'elle fut

* Hiſt. Nat. lib. v. c. 33.

campée, l'armée fut attaquée de la peſte ; et ce redoutable fléau qu'HOMERE dans ſon enthouſiaſme poétique attribue à la colère d'APOLLON, et aux imprécations du Prêtre CHRYSES, n'étoit, vraiſemblablement, que l'effet très ordinaire des vapeurs méphitiques, qui s'exhaloient du terrein marécageux où elle ſe trouvoit.

J'AI déjà remarqué dans le journal de mon voyage, qu'on trouve encore une quantité de joncs et de tamarins dans ces marais. Cette obſervation nous rappelle, que DIOMEDE après avoir tué le traître DOLON, dans les environs du camp, met ſes armes ſur un tamarin, et de peur de ne pas reconnoître, au milieu des ténèbres, l'endroit où il les avoit placées, il a ſoin de le marquer par un amas de roſeaux, et de branches de tamarins *.

QUANT au large baſſin circulaire, qu'on voit près du cap Rhetée, et que les Turcs appelent *Karanlik-Limani, le port fermé,* parce qu'il eſt en effet obſtruié par une barre de ſable, je ſerois aſſez tenté de croire que c'eſt le port des Achéens.

CHAP. XIV.

Tombeau d'Ajax.

HOMERE ne déſigne pas avec préciſion la poſition du tombeau d'AJAX ; mais il nous apprend, aumoins, que ſes cendres repoſoient dans la plaine de Troye, avec celle des autres guerriers Grecs.

" PLUT-

* Iliad. x. 465. vide etiam xxi. 17.

" PLUT-à-Dieu," dit ULYSSE, dans ſon voyage aux enfers, " que je n'euſſe pas remporté la victoire ſur AJAX ; la terre ne " couvriroit pas aujourd'hui les reſtes de ce héros *."

NESTOR racontant à TÉLÉMAQUE l'hiſtoire de la guerre de Troye, lui dit: " C'eſt là que repoſent le vaillant AJAX, ACHIL-" LE, et PATROCLE ſemblable aux Dieux, et mon fils, le cou-" rageux et l'innocent ANTILOQUE †."

AJAX, ſuivant DICTYS de Créte, indigné de ce que l'on avoit adjugé à ULYSSE le Palladium, menaça de ſa vengeance, et ſes juges, et ſon rival. Comme ceux-ci redoutoient, ſans doute, ſon courage, ils ſe tinrent ſur leurs gardes pendant la nuit ſuivante, et comme le jour ſuivant l'on trouva le guerrier ſans vie, chacun d'eux ſe montra très empreſſé de connoître la cauſe de ſa mort. NÉOPTOLEME, en attendant, fit apporter du bois pour bruler ſon corps ; il raſſembla ſes cendres dans une urne d'or, et il les dépoſa dans un tombeau, qu'il éleva en ſon honneur, près du cap Rhétée ‡.

STRABON, comme on l'a déjà dit, s'exprime clairement, à l'égard de la poſition de ce tombeau, dans ſa deſcription générale de la plaine de Troye.

UN certain Myſien apprit à PAUSANIAS, que le tombeau d'AJAX étoit ſitué près du rivage de la mer ; qu'une inondation en avoit altéré les formes, et découvert l'entrée: Et que l'on pouvoit ſe faire une idée de l'énorme taille de ce héros, par la grandeur des oſſemens qu'on y avoit trouvés ||.

L'OUVERTURE dont parle ici PAUSANIAS, ſur le rapport d'un Myſien, ſe voit encore au cap Rhetée, et les Turcs l'appellent, comme je l'ai déjà dit, In Tapé-gheulu, *la caverne du marais*. Comme le monument eſt renverſé depuis le ſommet juſqu'à ſa baſe, on diſtingue toute ſa conſtruction interieure, qui conſiſte d'abord dans une voute, en forme de croix, qui ſe trouve vers le milieu de ſa hauteur, et dans un noyau de maçon-

 nerie,

* Odyſſ. xi. 547.

† Ibid. iii. 109.

‡ De bello Troj. lib. v. c. 15.

|| Lib. v. 616.

nerie, autour duquel on a élevé des murailles circulaires à une petite diſtance les unes des autres, et décrites de differens centres.

L'HISTOIRE garde le ſilence ſur l'époque où le tombeau d'AJAX a été renverſé. Faut-il croire avec le Myſien, que les dieux indignés contre ce blaſphemateur, dirigerent les flots de l'Helleſpont contre ſa ſépulture? non. J'aime mieux ſuppoſer, que le grand POMPÉE, lorſqu'il enleva ſa ſtatue, s'empara de ſes cendres en même tems, pour les tranſporter en Egypte.

CHAP. XV.

Vallée de Thymbra.

LE nom très peu alteré de *Thimbrek*, que les Turcs donnent à cette jolie vallée, qui s'ouvre du côté du nord dans la plaine de Troye, ſa ſituation dans le voiſinage du tombeau d'ILUS, et du camp des Grecs, me rappela, ſur le champ, le récit du traître DOLON, qui pour éviter la mort, fait connoître à ULYSSE et à DIOMEDE les différens poſtes, qu'occupoient les Troyens et les auxiliaires. " HECTOR," leur dit-il, " tient conſeil ſur " le tombeau d'ILUS *, les Cariens, les Pœoniens, les Léleges, " les Myſiens, les Phrygiens, et les Mœoniens ſont dans la *vallée* " *de Thymbra* †."

LORSQU'après avoir reconnu cette vallée, et le fleuve qui la traverſe, je vins à obſerver au milieu d'un large marais, le point où ce fleuve ſe réunit au Simois, il me parut impoſſible d'expliquer comment les anciens, qui plaçoient ordinairement leurs temples dans les ſituations les plus avantageuſes, ou ſur de

* Iliad. x. 414.

† Ibid. 428.

de hauts promontoires, ou au milieu de riantes vallées, avoient auſſi mal choiſi celle du temple d'APOLLON. Ce point d'ailleurs aſſigné par STRABON, ou plutôt par ſes traducteurs, ſe trouvoit en contradiction avec la diſtance de cinquante ſtades, que ce géographe établit lui-même, entre la nouvelle Ilium et le temple d'APOLLON.

JE ſoupçonnai donc encore, quelque erreur dans STRABON, ou dans ſes traducteurs, et je ne tardai pas à m'en convaincre, lorſque je découvris les ruines d'un temple près du village de Halil-Eli, dans la vallée de Thimbrek, et que parmi ces ruines, je trouvai l'inſcription d'une offrande faite à APOLLON par les habitans d'Ilium. Pourquoi, en effet, auroit-on donné le ſurnom de Thymbréen au dieu qu'on adoroit dans ce temple, s'il n'avoit pas été ſitué dans la vallée de Thymbra?

ON ſait qu'ACHILLE fut tué dans ce temple, en allant épouſer POLYXÈNE, accompagné ſeulement de quelques fideles compagnons, et s'abandonnant à la foi des traités *. Comment PARIS et les Troyens auroient-ils eu la hardieſſe de tendre une pareille embuche au vaillant ACHILLE, et de l'exterminer, s'ils n'avoient pas été à une diſtance reſpectueuſe du camp des Grecs?

AU reſte, il n'eſt pas peut-être difficile de trouver dans STRABON, un ſens analogue à ces idées; il ſuffit de le ponctuer à propos pour le concilier avec la vérité.

" LE Thymbrius," dit-il, " ſe jette dans le Scamandre." Si l'on ſuppoſe ici une ſuſpenſion, la phraſe ſuivante nous apprend, " que près du Thymbrius ſe trouve le temple d'APOLLON, à cin-" quante ſtades d'Ilium *recens*, ou la nouvelle Ilium." Voilà ſans doute ce que STRABON voulu dire, et non pas que le Thymbrius ſe jette dans le Scamandre " près du temple d'APOLLON " Thymbréen †."

CHAP.

* DARES. Phryg. de Excidio Troj. c. xxiv.

† STRABO, p. 893.

CHAP. XVI.

Tombeau d'Ilus.

EN paſſant près des ruines du pont, qui ſe trouve vers l'emplacement de la nouvelle Ilium, j'apperçus, comme je l'ai déjà dit, ſur les bords du fleuve, une éminence qui, quoique très affaiſée, preſentoit une forme et des dimenſions à peu près ſemblables à celle du tombeau voiſin d'Udjek.

COMME cette éminence ſe trouvoit dans la plaine à très peu de diſtance du rivage de la mer, c'eſt à dire du camp des Grecs, je me rapelai, en la voyant, l'inquiétude de NESTOR, qui éveille DIOMÈDE, en lui diſant que les ennemis ſont à deux pas des vaiſſeaux, ſur le *throſmos* de la plaine *.

IL ne me parut donc pas douteux, que cette éminence ne fut le throſmos ; mais je ne bornai pas là mes conjectures, je me permis de les étendre plus loin, et je crus entrevoir que le throſmos et le tombeau d'ILUS, étoient le même monument, comme la colline Batieia et le tombeau de la courageux MYRINNE †. En effet, DIOMEDE averti par NESTOR, dont l'experience et la ſageſſe ont fait un eſpece de prophète, ſe met en marche avec ULYSSE, pour aller vérifier la poſition de l'ennemi. Ces deux guerriers rencontrent DOLON, eſpion Troyen, qui pour éviter la mort dont ils le menacent, leur apprend qu'en effet les Troyens ſont campés dans le voiſinage, (comme NESTOR le leur avoit déjà dit), et que HECTOR tient conſeil ſur le *tombeau d'*ILUS, avec les généraux Troyens ‡.

SI

* Iliad. x. 160. xi. 56. xx. 3

† Ibid. ii. 814.

‡ Ibid. x. 414.

Si la réunion de ces témoignages ne prouvent pas mathématiquement que le throſmos eſt la même choſe que le tombeau d'Ilus, il eſt au moins évident que ces deux monumens ne doivent pas être éloignés l'un de l'autre.

Suivons maintenant Priam, lorſqu'il va redemander à Achille le corps de ſon fils. Mercure rencontre le vieux roi, à l'entrée de la nuit, au moment où il arrivoit au tombeau d'Ilus *; et il le blâme de s'expoſer ainſi en voyageant de nuit avec ſes tréſors, dans la plaine de Troye †. Le tombeau d'Ilus étoit, donc, à une diſtance conſiderable de la ville, puiſque Priam qui en étoit parti de bonne heure dans l'après-dinée, comme on peut le voir dans la partie précédente du vingt-quatrième livre, n'y arrive que preſque à l'obſcurité de la nuit; la diſtance du même monument aux retranchemens des Grecs, devoit être beaucoup moindre, puiſque Mercure dit à Priam, qu'il en arrive à l'inſtant, et qu'il y conduit ſon char dans un clin d'œil ‡.

D'ailleurs le tombeau d'Ilus ne devoit pas être éloigné des bords du fleuve, puiſque Priam "après l'avoir paſſé, détache "le chevaux et les mules pour les faire boire ||."

CHAP.

* Iliad. xxiv. 349.

† Ibid. 365.

‡ Iliad. xxiv. 401. 443.

|| Ibid. xxiv. 350.

CHAP. XVII.

Situation de l'ancienne Troye.

QUAND les tombeaux trouvés ſur l'éminence de Bounarbachi, ne prouveroient pas d'une manière inconteſtable la poſition de l'ancienne ville de Troye, il y a pluſieurs circonſtances dans les deux poëmes d'HOMERE, qui ſeroient inexplicables et impoſſibles, ſi on la plaçoit par tout ailleurs.

LE village de Bounarbachi eſt ſitué ſur le penchant d'une éminence, expoſée à tous les vents. HOMERE, en parlant de la ville de Troye, lui donne l'épithète d'ἠνεμόεσσα *.

CE même village ſe trouve au fond d'une plaine immenſe, dont le terrein gras et noirâtre annonce la plus grande fertilité, et dont les productions actuelles nouriſſent les nombreux villages qu'on y voit. PARIS repondant aux injures d'HECTOR, lui propoſe de ſe meſurer avec MENELAUS dans un combat ſingulier, et lui dit: " quelque ſoit le vainqueur, vous autres " Troyens, après la paix, vous habiterez la *fertile plaine* de " Troye †, et les Grecs retourneront à Argos, pays abondant " en bons chevaux."

LE village de Bounarbachi eſt à quatre lieues de la mer. Le Troyen POLYDAMAS, après avoir combattu long tems près des vaiſſeaux des Grecs, donne à ſes compagnons le conſeil de ne pas attendre l'aurore pour retourner à Troye; " car," leur dit-il, " nous ſommes très eloignés des murailles ‡."

TOUT

* Iliad. iii. 305. viii. 499. xii. 115. xiii. 724. xviii. 174. xxiii. 64. 297.

† Ναίοιτε Τροίην ἐριβώλακα·—— Iliad. iii. 75. 257. vi. 315. xvi. 461. xxiv. 86. ix. 329. xviii. 67. xxiii. 215.

‡ Iliad. xviii. 256.

Tout près du village de Bounarbachi, on voit un marais couvert de roſeaux très épais et très élevés. Ulysse raconte à ſon fidele Eumée, qu'il avoit paſſé la nuit en embuſcade, près de la ville de Troye, et *au milieu de roſeaux* *.

La ville de Troye étoit inattaquable de tous les côtés, excepté du côté *de la colline des figuiers ſauvages*, qui s'étendoit entre les portes Scées, et les ſources du Scamandre †. Les précipices qui bordent l'eminence de Bounarbachi, et le Simois qui coule au pied de ces précipices, offriroient encore aujourd'hui des difficultés inſurmontables à toute armée qui voudroit s'en emparer; l'on n'en pouroit tenter l'attaque que du côté des ſources du Scamandre. Il ne croit plus de figuiers ſauvages dans cette eſpace particulier; mais cet arbriſſeau eſt très commun dans la plaine de Troye, et j'ai déjà fait obſerver la ſingulière analogie du nom que porte le village d'*Erin*, avec celui d'Erineos ‡, que portoit la colline voiſine de Troye; c'eſt près de cette colline, qu'étoient ſitués les jardins de Priam, où Lycaon *fut ſurpris par* Achille ‖, *coupant des branches nouvelles.* C'eſt là que ſont encore aujourd'hui ceux de l'Aga de Bounarbachi, qui, après quarante ſiècles, ſuccéde au roi des Troyens dans ſa capitale, dans une partie de ſes poſſeſſions, et dans ſon empire abſolu ſur les habitans de la plaine de Troye, et ſur les Agas inférieurs qui les commandent.

Les épithètes d'*ἄκρος, ἀκροτάτος*, qu'Homere donne partout à la citadelle de Troye, m'autoriſoient bien à croire, qu'elle étoit ſituée ſur une éminence §; mais je m'étonnois toujours, que ce grand poëte n'eut pas fait mention de ces précipices de Bounarbachi, qui dominent le Simois, et dont l'aſpect effrayant et pittoreſque, étoit cependant ſi digne de ſon pinceau. Ce n'eſt qu'en ſuivant ſes deux poëmes vers par vers, mot par mot,

 que

* Odyſſ. xiv. 473.

† Iliad. vi. 433. xxii. 145.

‡ Iliad. vi. 433.

‖ Ibid. xxi. 35

§ Ibid. v. 460. vi. 88. 257. 317. 512. xx. 52. xxii. 172. iv. 508. vii. 21. xxiv. 700. Odyſſ. viii. 494. 504.

que j'ai pu découvrir, que ces hauts rochers qui faisoient la plus sure défense de la ville de Troye, n'avoient pas été oubliés. DEMODOCUS vantant les exploits, et les ruses d'ULYSSE, raconte comment le cheval de bois fut conduit dans la citadelle : " Aussi-" tôt," dit-il, " que les Troyens l'eurent trainé sur le sommet " de l'acropolis, ils tinrent conseil, pour délibérer si on lui " ouvriroit les flancs, si on en feroit hommage aux dieux pour " les appaiser, ou si *on le précipiteroit du haut des rochers* *."

LA colline Batieia, où le tombeau de la courageuse MYRINNE étoit en face de la ville †. C'étoit là, que les Troyens, et les auxiliaires, se rangeoient en bataille, tandis que l'armée des Grecs s'étendoit du côté des vaisseaux ‡. Ce tombeau ne subsiste plus, mais il suffit d'examiner la carte ; on voit qu'en disposant l'armée Troyenne entre les rives des deux fleuves, de manière qu'une des ailes soit appuyée sur les bords du Simois, vers *Aktché Keu*, où est Callicoloné, et l'autre vers les bords du Scamandre, un peu au dessous de Bounarbachi, où devoit être le tombeau de MYRINNE, alors elle fait face à l'armée Greque, située entre le cap Sigée et le cap Rhetée.

LES divinités protectrices de ces deux armées, ne pouvoient mieux exciter leur courage, qu'en parcourant alternativement leurs lignes ; c'est ainsi qu'en agissent tous les généraux, au moment où ils conduisent leurs troupes à l'ennemi. Aussi voyons-nous MARS appeler les Troyens, à grands cris, du haut de la citadelle, et volant comme un tourbillon sur les bords du Simois vers Callicoloné ; tandis que PALLAS, animant, de son côté ; l'armée Greque, se trouve, tout à la fois, au cap Sigée, au cap Rhetée, et sur le rivage de la mer ‖.

LA route publique passoit près des sources du Scamandre, puisqu'HECTOR poursuivi par ACHILLE arrive aux sources, après l'avoir traversée §. On arrive encore aujourd'hui des rivages

* Odyss. viii. 504.

† Ibid. ii. 811.

‡ Iliad. ii. 464.

‖ Iliad. xx. 48.

§ Ibid. xxii. 145.

rivages de l'Hellefpont au village de Bounarbachi en paffant fur les fources du Scamandre.

Si toutes ces preuves réunies, ne fuffifent pas pour fixer irrevocablement la fituation de l'ancienne Troye, je me flatte qu'on fe laiffera dumoins convaincre, par la démonftration mathématique et rigoureufe qui va fuivre.

Les portes Scées, (ou les portes du couchant), étoient celles qui faifoient face à la plaine *. C'eft par ces portes, que les Troyens fortent, pour aller combattre dans la plaine; c'eft là, qu'Hector étoit placé lorfque Priam et Hecube veulent le détourner de fe mefurer avec Achille †. C'eft enfin du haut de ces portes, que ces infortunés parens, voyent perir leur fils aux fources du Scamandre ‡.

Les fources du Scamandre étoient, donc, en face, et à la vue, des Portes Scées. Elles étoient, donc, au couchant de la ville. Dès qu'une fois l'on m'accorde la pofition des fources du Scamandre, on ne fauroit me refufer celle de la ville de Troye. La fituation de cette ville à l'orient des fources, eft inconteftable et rigoureufement démontrée.

k 2 CHAP.

* Eustath. in Iliad. vol. i. p. 394. Edit. Rom. 1550.

† Iliad. xxii. 35. ‡ Ibid. xxii. 405.

CHAP. XVIII.

Tombeau d'Hector.

C'EST une opinion généralement répandue parmi les érudits, que les anciens ne plaçoient jamais leurs ſépultures dans l'intérieur des villes. Les ruines de celles qu'on a découvertes, et les uſages actuels des nations orientales, ſemblent confirmer cette opinion ; mais on ſait que quelques peuples, tels que les Lacédémoniens, par exemple, n'imitoient point en cela les autres, et qu'ils entaſſoient avec autant d'inhumanité que nous, les morts, et les vivans, dans l'étroite enceinte de leurs murailles.

LES Troyens n'auroient-ils point imité ce barbare uſage ? et les tombeaux que l'on voit ſur l'éminence de Bounarbachi, et qui devoient d'après leur ſituation préſente, être enfermés dans la ville, ou aumoins dans la citadelle de Troye, ne ſembleroient-ils pas l'indiquer ? non. Les tombeaux d'ÆSYETES, d'ILUS, de la courageuſe MYRINNE, étoient hors des murailles, et même à une grande diſtance de la ville ; pourquoi donc ceux-ci ſe trouvent-ils dans l'interieur ? La raiſon en eſt ſimple.

LORSQU'UN des chefs des Grecs venoit à perir dans le combat, on le portoit aux vaiſſeaux, et on lui élevoit un tombeau ſous la protection du camp. Les Troyens, au contraire, lorſqu'ils vouloient executer la cérémonie des funerailles de leurs guerriers, n'avoient d'autre défenſe contre les incurſions des Grecs, que les murailles de leur ville. Il ne ſeroit donc point étonnant, qu'ils ayent été forcés pendant le tems de la guerre, de

de déroger à leur ancien uſage, et d'enterrer les morts dans leur enceinte.

J'AI déjà dit, que des quatre tombeaux qui ſe trouvent ſur l'éminence de Bounarbachi, trois ſont abſolument ſemblables à ceux qu'on voit ſur les rivages de l'Helleſpont, et que le quatrième eſt un énorme amas de pierres, qui ſemble avoir été bouleverſé ; et après m'être aſſuré mathématiquement de la ſituation de l'ancienne Troye, ma première idée fut, qu'ils contenoient les cendres des guerriers Troyens ; et ma conjecture à cet égard me paroiſſoit d'autant plus raiſonnable, que pluſieurs auteurs anciens nous apprennent que long tems après la guerre de Troye, on montroit aux voyageurs les tombeaux des Troyens, auſſi bien que ceux des Grecs. " Le corps de PARIS," dit DARÈS de Phrygie *, " fut porté dans la ville, et PRIAM lui éleva un " tombeau."

CESAR, parcourant la plaine de Troye, marchoit ſans s'en appercevoir ſur un monceau de pièrres et de gazon, qui n'avoit plus la forme d'un tombeau. " Arretez, CESAR," s'écrie ſon conducteur, " vous foulez aux pieds les cendres d'HECTOR."

——— *Securus in alto*
Gramine ponebat greſſus; Phryx incola manes
HECTOREOS *calcare vetat* †.———

PAUSANIAS, qui nous à déjà fait le récit fabuleux des cauſes qui avoient renverſé le tombeau d'AJAX, nous apprend auſſi le motif qui fit ouvrir celui d'HECTOR : " Les habitans de " Thèbes," dit-il, " furent engagés par l'oracle d'aller à Troye, " chercher les cendres d'HECTOR, et de les tranſporter à " Thèbes ‡."

VIRGILE

* De Excidio Trojæ, cap. xxxv.

† LUCAN. Pharſ. ix. 975.

‡ Græc. Deſcrip. lib. ix. p. 568. Edit. Hanov. 1613.

VIRGILE nous déſigne d'une manière très ingenieuſe, la véritable ſituation du tombeau d'HECTOR.

" ENÉE," dit-il, " abordant ſur les rivages de l'Epire, y
" rétrouve la ville de Troye, le Scamandre, la Citadelle, et les
" portes Scées :

Procedo, et parvam Trojam, ſimulataque magnis
Pergama, et arentem Xanthi cognomine rivum
Agnoſco, Scææque amplector limina portæ *.

Il rencontre ANDROMAQUE, faiſant des libations ſur le tombeau de ſon époux :

——— *falſi Simoëntis ad undam,*
Libabat cineri ANDROMACHE, *maneſque vocabat*
HECTOREUM *ad tumulum* †. ———

CETTE infortunée Princeſſe, cherche dans ſa nouvelle patrie, ce qu'elle a perdu dans l'ancienne. Elle donne à un ruiſſeau deſſéché le nom du Scamandre dont les eaux limpides ne tariſſent jamais, et dont les bords ſont toujours fleuris. Elle éleve le cenotaphe d'HECTOR, ſur les rives du faux Simois, ſes ſouvenirs douloureux alimentent ſes larmes, et ils lui ſont trop precieux pour qu'on puiſſe les accuſer d'être infideles. On peut s'en rapporter à cette veuve affligée, pour le ſoin d'imiter le tombeau de ſon cher HECTOR, et dès qu'ANDROMAQUE pleure ſur les bords du faux Simois en Epire, c'eſt que les cendres de ſon époux repoſent ſur les rives du véritable Simois dans la plaine de Troye.

JE les ai vus, Meſſieurs, ces rivages de l'Epire, où regnoit autrefois HELENUS. La plaine de Butrinto, ſituée en face de l'île de Corfou, a, en effet, des rapports ſinguliers avec la plaine de Troye ; et le village de Butrinto, comme celui de Bounarbachi,

* Æn. iii. 349. † Ib. 302.

bachi, eſt auſſi ſitué ſur une éminence, à l'extremité d'une plaine entourée de montagnes, traverſée de deux petits torrents, et s'étendant jusqu'à la mer.

La deſcription qu'Homere nous a laiſſée, lui-même, des funerailles d'Hector, s'accorde merveilleuſement avec tous les témoignages que je viens de citer; " On brule le corps de ce " guerrier, on éteint la flamme avec du vin ; ſes parens, et ſes " compagnons raſſemblent ſes cendres en verſant des larmes ; " ils les enferment dans une urne d'or, et ils les dépoſent dans " une foſſe, qu'ils couvrent d'une quantité de pierres, et ſur " laquelle ils élevent un tombeau *."

CHAP. XIX.

Des Sources du Scamandre.

J'AI dit dans mon journal, en décrivant les ſources trouvées dans la plaine de Troye, qu'elles étoient voiſines du village de Bounarbachi ; j'ai ajouté, que celle qui eſt iſolée, et qui jaillit du fond du baſſin bordé de piliers de marbre et de granit, étoit en hyver chaude, et couverte de fumée; tandis que les autres nombreux filets d'eau, qui ſortent du pied de la colline voiſine, et qui ſe réuniſſent enſuite, pour former la ſeconde ſource du plus petit des fleuves, conſervoient en tout tems la même temperature. Voyons ſi ces caractères correſpondent à la peinture qu'Homere nous a laiſſée des ſources du Scamandre.

Ces

* Iliad. xxiv. 797.

Ces ſources, ſuivant lui, n'étoient pas éloignées de la ville, puiſque les femmes Troyennes alloient y laver leurs vètemens, avant l'arrivée des Grecs *. Il paroît auſſi, que le phénomene très extraordinaire qui diſtingue ces ſources, n'a pas échappé non plus à ce grand poëte. On voit clairement dans le tableau détaillé qu'il en donne, qu'il n'avoit pas été moins frappé de leur ſingulière différence que de leur abondance, et de leur beauté ; mais l'idée qu'il nous en donne n'eſt pas tout-à-fait conforme à la nature, ou n'eſt pas, au moins, exactement rendue : " L'une de ces ſources," dit-il, " eſt tiede, et couverte " de fumée, l'autre, en été, eſt froide comme la neige ou la " grêle †." La première ſource, eſt réellement tiede et couverte de fumée ; mais elle ne l'eſt pas toujours, comme Homere ſemble l'indiquer, et ne l'eſt qu'en hyver ; et l'autre eſt toujours froide.

Les environs des ſources du Scamandre, étoient couverts de roſeaux très épais, et très élevés, dans leſquels les jeunes filles de Troye, alloient ſe baigner avant leurs nôces, et où la jeune Callirhoé fut abuſée par l'Athenien Cimon, ſuivant l'aventure qui força Eschine de s'échapper précipitamment de la Troade, et qui eſt racontée dans la dixième des lettres qu'on attribue communement à cet orateur ; aventure véritablement déplorable, puiſqu'elle l'empêcha d'obſerver la plaine de Troye, et qu'elle nous a privé du réſultat de ſes recherches.

On peut, quoique il en ſoit, conclure de cette lettre, que la ville de Troye exiſtoit encore au tems d'Eschine ; qu'elle étoit voiſine du Scamandre ; que ce fleuve étoit couvert de roſeaux, comme aujourd'hui ; qu'Eschine s'attendoit à rétrouver la plaine, à peu près, dans le même état où Homere l'avoit depeinte.

Il n'eſt pas inutile de remarquer, non plus, que ce même lutteur Attalus, cité dans la lettre d'Eschine, eſt le même qui

* Iliad. xxii. 154. † Ibid. 149.

qui eſt mentionné dans l'inſcription trouvée parmi les ruines du temple d'APOLLON Thymbréen.

SI je ne craignois paroître romaneſque dans ma deſcription de la plaine de Troye, j'ajouterois, que j'ai trouvé des femmes Turques du village de Bounarbachi, lavant leur linge aux ſources du Scamandre, comme les épouſes et les filles des Troyens le faiſoient lorſqu'avant l'arrivée des Grecs, elles jouiſſoient des douceurs de la paix :

——— ὅθι εἵματα σιγαλόεντα
Πλύνεσκον Τρώων ἄλοχοι, καλαί τε θύγατρες,
Το πρὶν ἐπ' εἰρήνης, πρὶν ἐλθεῖν υἷας Ἀχαιῶν *.

CHAP. XX.

Courſe d'Hector et d'Achille.

LORSQU'ACHILLE va provoquer HECTOR aux portes Scées †, l'armée Grèque eſt rangée en bataille dans la plaine, à la vue des murs de Troye. Les Troyens ſont réduits aux abois. HECTOR eſt le ſeul obſtacle qui puiſſe ſuſpendre un moment leur perte : Les citoyens ſont ſur les murs, qui ſont face à la plaine, et aux ſources du Scamandre. PRIAM et HECUBE ſont ſur les portes Scées ‡ ; toutes les forces de la ville ſont dirigées au point que les ennemis menacent d'attaquer ; chacun tremble pour le ſort du vaillant HECTOR, qui eſt, en ce moment, le ſeul rempart qu'on puiſſe oppoſer aux Grecs victorieux. ACHILLE

* Iliad. xxii. 154.

† Ibid. 35. 131.

‡ Iliad. xxii. 76. 78.

va à ſa rencontre, ſon aſpect l'intimide, il prend la fuite*, (et s'il faut s'en rapporter à l'opinion commune des traducteurs d'HOMERE), il ſe met à courir *autour* des murs de la grande ville de Troye †. Chaque fois qu'il cherche à gagner les portes, ou à s'approcher des murs, ACHILLE le détourne vers la plaine, et fait ſigne à ſes ſoldats de ne pas attenter à ſa vie ‡.

CES deux guerriers ne courent pas pour une victime; il s'agit de la vie du grand HECTOR §, c'eſt à dire, du ſalut ou de la perte de Troye. Tous ſes concitoyens, et ſa famille, ſont rangés ſur les murs, pour attendre de quel côté la balance de JUPITER penchera. La courſe des deux guerriers eſt l'époque la plus déciſive, et le ſpectacle le plus intéreſſant pour les Troyens, et pour les Grecs. Ils ne doivent pas en perdre la moindre circonſtance. Chaque pas que fait HECTOR, doit retentir au fond du cœur de PRIAM et d'HECUBE, et les braves Theſſaliens doivent exciter à grands cris la viteſſe de leur roi.

SI ces deux guerriers s'étoient dérobés aux yeux de leurs armées, et avoient continué leur courſe autour des murailles, de l'immenſe ville de PRIAM, les portes Scées ſeroient-elles reſtées à la diſcrétion de l'armée Greque? Cette armée n'étant plus contenue par la préſence de ſon chef, et dans l'incertitude de ce qui ſe paſſoit entre les deux guerriers, lorſqu'ils étoient dans la partie oppoſée de la ville, ſeroit-elle reſtée dans l'inaction, et auroit-elle pu moderer ſon impatience, juſqu'à ce qu'ils euſſent fait trois fois le tour des murailles?

COMPARONS, maintenant, le combat de TURNUS et d'ENÉE, avec celui d'HECTOR et d'ACHILLE. Ceux-là combattoient ſous les murailles de Laurentum, entre deux armées qui attendoient avec une égale impatience l'arrêt de leur deſtinées; voyons comment VIRGILE aura terminé cette importante bataille.

TURNUS ayant réſolu d'engager ENÉE dans un combat ſingulier, et celui-ci étant informé du projet de ſon adverſaire, tous deux ſe préparent au combat. De bonne heure le matin ſuivant;

* Iliad. xxii. 136.
† Ibid. 144. 165.
‡ Iliad. xxii. 194. 205.
§ Ibid. 158.

ſuivant, les Troyens et les Rutules tracent le champ de bataille, ſous les murailles de la grande ville *. Les mères inquietes, la foule du peuple, et les foibles vieillards, ſe placent ſur les tours, ſur le toit des maiſons, et ſur le haut des portes. JUNON du ſommet de la montagne voiſine, domine ſur le champ de bataille, ſur les deux armées, et ſur la ville de LATINUS. Ce roi, accompagné de TURNUS ; et ENÉE, accompagné de ſon fils ASCAGNE, conviennent des préliminaires du combat, et font un traité qu'ils confirment par les ſermens les plus ſolemnels.

EN attendant, JUTURNE, ſœur de TURNUS, à l'inſtigation de JUNON, ſe prépare à faire violer le traité, et à déconcerter les projets du combat. Une bataille générale eſt la ſuite de cette ruſe. ENÉE y eſt bleſſé, et ſe retire ; ſa bleſſure eſt guerie bientôt après, par le ſecours de VENUS. Mais TURNUS, profitant de l'abſence de ſon rival, fait un carnage affreux dans ſon armée. Le poëte place ici pluſieurs incidens. ENÉE retourne au combat, il attaque la ville de Laurentum, et brule les maiſons les plus voiſines du rempart. TURNUS, enfin, dans un accés de violence et de déſeſpoir, cherche partout ſon rival. " Il s'avance juſques ſous les murailles, où le combat eſt le plus " acharné, et où les dards ſifflent à travers les airs ; il fait ſigne " aux Rutules de la main, et leur crie de ne plus combattre, en " leur declarant, que c'eſt à lui ſeul de courir les hazards de cette " journée, quels qu'ils puiſſent être ; et qu'il doit remplir pour " eux toutes les conditions du traité, par la ſeule force de ſes " armes ; auſſitôt les armées ſe ſéparent, et laiſſent entr'elles un " grand eſpace †." ENÉE, qui s'en apperçoit, abandonne l'attaque des murailles, et court ſe meſurer avec TURNUS. Le combat s'engage, l'attention des deux armées eſt entièrement fixée ſur leurs chefs : JUPITER peſe leurs deſtinées, comme il avoit autrefois, ſuivant HOMERE, peſé celles d'HECTOR et d'ACHILLE. L'épée de TURNUS, qui n'étoit pas la ſienne, mais qu'il avoit arachée par hazard à ſon cocher METISCUS, ſe briſe en éclats, contre la divine armure d'ENÉE. Il n'a plus d'autres reſources

l 2 que

* Æn. xii. 116.

† Æn. xii. 690.

que la fuite ; alors les deux combattans font cinq fois, en courant, le tour du champ de bataille, et autant de fois ils se retrouvent au même point *.

TURNUS s'arrête près d'un olivier consacré au dieu FAUNE, comme HECTOR s'arrête près des sources du Scamandre. Si dans le combat HECTOR lance, en vain, sa pique contre ACHILLE, dont les armes divines résistent à son effort ; s'il crie vainement à DÉIPHOBE de lui en donner un autre ; TURNUS voit, de même, se briser dans ses mains l'épée qui le trahit, et il en demande une autre aux soldats qu'intimidoient les menaces d'ENÉE.

CETTE course circulaire de TURNUS poursuivi par ENÉE, s'exécute non pas autour de la ville de Laurentum, mais sous les murs de cette ville, toujours du même côté, et dans un terrein compris entre cette même ville, un marais, et l'armée des Troyens † ; circonstance que VIRGILE semble avoir supposée pour former à ses combattans une arène, semblable à celle qu'offroit la plaine de Troye, pour les contenir sur le même théatre, toujours sous les yeux de leurs concitoyens ; enfin pour donner à sa composition une sorte d'unité, et pour ne pas blesser la vraisemblance, et le bon goût.

POURQUOI VIRGILE, après avoir suivi son modèle pas à pas, depuis le commencement de l'épisode, paroît-il s'en écarter, relativement à la course particuliere de ses deux guerriers ? Auroit-il risqué de corriger son sublime original dans une circonstance aussi importante ? L'ouvrage d'HOMERE qu'il avoit, étoit-il différent de celui qui existe aujourd'hui ? Ou le texte même

* *Quinque orbes explent cursu, totidemque retexunt*
Huc, illuc—————— Æn. xii. 763.

† *Et nunc huc, inde huc, incertos implicat orbes;*
Undique enim densa Teucri inclusêre coronâ;
Atque hinc vasta palus, hinc ardua mœnia cingunt. Ibid. 744.

même feroit-il fufceptible d'admettre l'explication que VIRGILE femble lui avoir donnée ?

EN fuppofant que le texte n'ait point été alteré, il ne me paroît pas impoffible d'y trouver un fens analogue à l'imitation de VIRGILE, et de juftifier ainfi fon modèle.

L'EXAMEN fcrupuleux que j'ai fait de cet épifode m'a convaincu, que la difficulté préfente confifte effentiellement, et uniquement, dans la manière d'interpréter la prépofition περὶ, qui fignifie fouvent *autour*, mais qui eft également employée dans plufieurs auteurs, et dans HOMERE lui-même, pour les mots *juxta*, *propè*, *ad*, qui defignent le voifinage d'un lieu. Si au lieu d'adopter περὶ dans le premier fens, on le prend dans le dernier, la difficulté difparoît, les guerriers courent *devant*, ou *près* de la ville; il ne fubfifte plus aucune différence entre les deux epifodes de l'Iliade et de l'Enéide; et le grand HOMERE eft juftifié d'une faute de goût dont la mal-adreffe de fes commentateurs l'a, jufqu'à préfent, fait accufer.

CHAP. XXI.

Tombeaux d'Achille, de Patrocle, et d'Antiloque.

L'OBSERVATEUR le moins éclairé, le ſimple matelot lui-même, eſt frappé de ces éminences coniques, qui ſont rangées ſur les bords de la mer, et qu'il apperçoit ſucceſſivement, à meſure qu'il s'avance dans l'Helleſpont. Il faut bien que ces monumens ayent un but, et une deſtination; on n'élève pas des maſſes de cette importance, ſans un objet quelconque. Les Turcs qui ont, ſans doute, reçu cette tradition des Grecs, prétendent que ce ſont des tombeaux d'anciens Sultans, et d'anciens Vizirs, c'eſt à dire, d'anciens rois, et d'anciens généraux; car on ſait, que les Turcs, comme les autres nations, donnent à tous les ſouverains, et à tous les chefs, le nom des leurs. Jamais les Sultans ni les Vizirs n'ont été enterrés à la manière des guerriers Grecs. A Brouſſe, à Magneſie, à Conſtantinople, dans toutes les villes où ils ont reſidé, leurs cendres repoſent dans de magnifiques moſquées, qu'ils ont preſque toutes éleveés de leur vivant.

LE Docteur POCOCKE a mal interprété cette tradition des Turcs. S'il l'avoit adoptée dans ſon véritable ſens, elle auroit, peut-être, levé ſes doutes, et il ſe ſeroit montré moins timide dans le jugement qu'il a porté ſur les monumens de la Troade.

PLINE, STRABON, PAUSANIAS, DION CHRYSOSTOME, et beaucoup d'autres anciens rapportent, comme je l'ai déjà dit, que les tombeaux des guerriers Grecs étoient encore de leur tems en evidence, ſur les rivages de l'Helleſpont. Ils avoient donc reſiſté plus de dix ſiècles aux injures des ſaiſons. Les reſpect

ſpect des peuples, autant que leur ſolidité, les avoit garantis de la deſtruction, pourquoi n'auroient-ils pas ſubſiſté vingt ſiècles de plus? lorſque, ſur-tout, les peuples devenus dans la ſuite maîtres du pays où ils ſe trouvent, n'ont pas moins de vénération pour les ſépultures que ceux qu'ils en ont chaſſés.

Il n'y a donc rien d'étonnant, ſi les deux célèbres Anglois qui m'ont précédé dans la Troade, n'ont pas craint, l'un de ſoupçonner, l'autre d'affirmer hardiment qu'ils exiſtoient encore; mais quand tous les voyageurs, tant anciens que modernes, ne m'auroient pas guidé dans la recherche des monumens de la Troade, la preciſion avec laquelle Homere décrit leur ſituation, leur conſtruction et leur forme, l'aſſurance avec laquelle il prophétiſe en quelque ſorte leur éternelle durée, auroient ſuffi pour me les faire decouvrir, et pour m'autoriſer à croire à leur exiſtence actuelle. Ecoutons, d'abord Achille faiſant executer les funérailles de Patrocle, " Je lui ai fait," dit-il, " élever un tombeau d'une grandeur médiocre, mais " j'ordonne aux Grecs qui me ſurvivront, d'en conſtruire un " plus haut, et plus étendu que celui-ci *."

Agamemnon racontant à Achille dans les enfers, les cérémonies de ſes funérailles: " La déeſſe, votre mère," lui dit-il, " donna une urne d'or pour enfermer vos cendres, et elle " dit, que c'étoit un préſent de Bacchus, et un chef-d'œuvre " de Vulcain. Vos os ſont dans cette urne, mêlés avec ceux " de Patrocle; et dans la même urne on mit ſéparément, " ceux d'Antiloque, qui, après Patrocle, étoit celui de " vos compagnons que vous chériſſiez le plus. Toute l'armée " travailla enſuite à élever ſur ces précieux reſtes un tombeau, " que l'on plaça ſur le haut rivage de l'Helleſpont, afin qu'il " ſoit apperçu de loin par les navigateurs qui paſſeront dans " cette mer, non ſeulement dans ce ſiècle, mais dans les ſiècles " à venir †."

L'image des tombeaux des grands hommes, a quelquechoſe de touchant, qui intéreſſe le cœur à coup ſûr. Homere, qui

* Iliad. xxii. 245.

† Odyſſ. xxiv. 73.

qui connoiſſoit tous les reſſorts qui peuvent emouvoir la ſenſibilité, n'a pas manqué d'employer un moyen dont il attendoit, avec raiſon, les plus grands effets ſur l'âme de ſes lecteurs. Voyez combien de fois il rapelle le ſouvenir de ces lugubres monumens, et avec quel intérêt il les décrit ; il ſemble qu'il y voit d'avance bruler l'encens des ſacrifices, qu'il entend les ſoupirs, et qu'il voit couler les larmes des voyageurs qui les viſiteront un jour.

QUAND HECTOR provoque les guerriers Grecs au combat ſingulier, il propoſe au milieu des deux armées les conditions du combat : " Si je fais tomber," dit-il, " mon ennemi ſous mes " coups, ſi APOLLON m'accorde la victoire, j'emporterai ſes " armes dans la citadelle d'Ilium ; je les ſuſpendrai au temple " de ce dieu, et je renverrai ſon corps dans ſes vaiſſeaux, afin " que les Grecs lui faſſent des funérailles honorables, et qu'ils " lui élevent un tombeau ſur le rivage de l'Helleſpont, en ſorte " que dans les ſiècles à venir, quand les voyageurs paſſeront " dans cette mer ils diſent : Voila le tombeau d'un vaillant " guerrier, qui dans le tems paſſé, fut vaincu par le belliqueux " HECTOR dans un combat ſingulier ; ainſi parleront tous les " voyageurs, et ma gloire paſſera d'âge en âge *."

HOMERE nous apprend expreſſement, que le monument d'ACHILLE et de PATROCLE, étoient de cette eſpece, et qu'ils étoient ſitués ſur le rivage de la mer, en nous diſant : " Que " les hommes chargés de tranſporter du mont Ida les bois né" ceſſaires pour le bucher de PATROCLE, les jettent, par ordre, " ſur le rivage, à l'endroit qu'ACHILLE avoit déſigné pour le " tombeau de PATROCLE, et pour le ſien †."

IL va nous décrire maintenant leur conſtruction et leur forme : " Les chefs," dit-il, " en parlant du tombeau de PA" TROCLE, en marquent l'enceinte circulaire, ils en jettent les " fondemens, et il les couvrent d'un monceau de terre."

JE

* Iliad. vii. 81. † Ibid. xxiii. 123.

Je m'arrête avec enchantement ſur ce tableau, dont les détails ſont ſi précieux pour établir l'authenticité des monumens que j'annonce. "On trace l'enceinte du tombeau en forme de "cercle:" En effet, tous les tombeaux de la plaine de Troye ſont en forme circulaire. "On en jette enſuite les fonde-"mens:" Il y avoit donc des conſtructions intérieurs; et Homere nous apprend quel étoit leur uſage: "On verſe de la "terre ſur ces conſtructions *." Cette terre dont il déſigne la mobilité par l'épithète χυτὴ, ſe ſeroit aiſément éboulée, et n'auroit pas reſiſté long tems aux injures de l'air, ſi l'on n'avoit pas eu ſoin de la ſoutenir par un noyau de maçonnerie.

Il exiſte encore, ce précieux monceau de terre élevé par la main des Grecs. Ce ne ſont plus comme autrefois des ormeaux qui l'entourent; ce ſont aujourd'hui de hauts peupliers, et de lugubres cyprès encore plus triſtes et plus amis des ſépultures.

Le Docteur Chandler regarde avec raiſon comme celui d'Antiloque, le tombeau voiſin d'Jeni-chehr, ſur le ſommet du promontoire; mais je ne ſais quel motif il a de regarder le ſuivant comme celui de Péneleus.

Quoiqu'il en ſoit, il eſt probable d'après la deſcription d'Homere, que les deux tombeaux élevés en l'honneur de Patrocle et d'Antiloque ſont de ſimples cénotaphes, ou qu'ils ne contiennent rien, puiſque les cendres de ces deux guerriers furent mêlées avec celles d'Achille, et placés dans ſon tombeau.

Pénétré de cette idée, dirigé d'ailleurs par la groſſeur de celui de ces monumens qui eſt le plus près de la mer, et par le nom ſingulier de *Dios-Tapé*, "tombeau du dieu," que lui donnent encore les Grecs du cap Sigée, je le marquai, comme devant, être l'objet de la fouille que je conſeillai d'entreprendre.

Après mon départ de Conſtantinople, malgré la vigilance des Turcs, on eſt venu à bout, au moyen de quelques préſens faits

* Iliad. xxiii. 255, 256.

faits aux commandans du fort voiſin, d'executer cette perilleuſe entrepriſe. Vers le centre du monument, on a trouvé deux larges pierres, appuyées à l'angle l'une ſur l'autre, et formant un eſpece de tente, ſous laquelle, on a trouvé d'abord une petite ſtatue de MINERVE Panthée, montée ſur un quadrige, et une urne de metal, remplie de cendres, de charbons, et d'oſſemens humains. Cette urne, qui eſt maintenant entre les mains du Comte de CHOISEUL, eſt entourée d'une branche de vigne, à laquelle ſont ſuſpendues des grappes de raiſin executées avec un art infini.

SONT ce-là les cendres d'ACHILLE ? Je n'en ſais rien ; mais ce ſont, à coup ſûr, celles d'un perſonnage qui honoroit MINERVE d'un culte particulier, puiſque la ſtatue de cette déeſſe ſe trouve avec ſes cendres. De plus, il eſt mort dans un ſiècle où c'étoit l'uſage de bruler les cadavres, puiſque voila des cendres, des charbons, et des oſſemens encore très réconnoiſſables ; et quand je vois cette urne de bronze, ornée de pampres, j'avoue qu'il m'eſt bien difficile de ne pas ſonger à cette autre urne, préſent de BACCHUS et ouvrage de VULCAIN, que THETIS donna aux Grecs, pour y enfermer les cendres de ſon fils.

MAIS, me dira-t-on, Comment ces cendres ſe ſont-elles conſervées ſi long tems ? Comment ont-elles reſiſté plus de trois mille ans à l'injure des ſaiſons ? C'eſt qu'elles n'y étoient pas expoſées. La voute ſous la quelle elles ſe trouvoient, étoit couverte d'une couche énorme de ſable fin, ſur laquelle on en avoit étendu une autre, encore plus épaiſſe, de terre glaiſe ; et ſur le tout, on avoit élevé une haute montagne. Par ce moyen, l'urne étoit défendue de l'humidité, et du contact de l'air, qui ſont les deux grandes cauſes de la diſſolution.

" CE n'eſt pas tout," ajoute le célèbre auteur du *Voyage d'Anacharſis*, le ſavant et vertueux Abbé BARTHÉLEMY, " ces " grappes de raiſin placées ſur l'urne ſont executées dans une " perfection qui ne convient point au ſiècle d'HOMERE."

A

A CETTE difficulté je pourrois répondre, avec BOULANGER, " Que le ſiècle d'HOMERE, quel qu'il ſoit, a été ſuivi de " pluſieurs ſiècles d'ignorance, qui n'ont conſervé ſon livre " que dans la pouſſière, et qui en ont fait oublier l'auteur." Je dirois de cet auteur, quel qu'il ſoit encore, qu'il n'a pu appartenir qu'à un ſiècle éclairé, parce qu'il nous préſente un genie ſublime, orné de connoiſſances très étendues ; et parceque le language de la Grece a, dans l'Iliade, une beauté, une fineſſe, et une perfection, qui n'ont pu être que les ſuites d'un progrès infini dans le commerce, dans les arts, et dans les lettres.

CEPENDANT pour ne pas choquer gratuitement les érudits, pour ne pas contredire ſans raiſon les annales, les marbres, et la chronologie de la Grèce, nous pouvons comparer, je penſe, le dégré de civilization des Grecs au tems d'HOMERE et d'ACHILLE, à celui des Turcs de nos jours. Ceux-là, quoique très ignorans dans les arts, commerçoient avec l'Egypte et l'Aſie, comme les Turcs le font avec la France et l'Angleterre. J'ai vu chez pluſieurs Pachas, des pendules à Equation, et des ſpheres, et je ne les ai pas accuſés pour cela, d'être aſtronomes. ACHILLE put acheter un bouclier d'un Egyptien, comme un janiſſaire achete un fuſil d'un Anglois, et ceux qui prirent ſoin de ſes funeraillés purent, de la même manière, ſe procurer une urne élégante pour y dépoſer ſes cendres.

QUANT à ceux qui demandent, ſi j'ai trouvé des inſcriptions ſur les tombeaux de la Troade, je leurs réponds, qu'il ne paroît pas certain, que les inſcriptions en caractères écrits, fuſſent en uſage au tems de la guerre de Troye, puiſque HOMERE, n'en fait aucune mention ; mais les vers d'un grand poëte, lorſqu'ils peignent la ſituation et la forme d'un monument, que ſa ſolidité et ſa maſſe impoſante mettent à l'abri des injures du tems, ſont des inſcriptions plus durables qu'une plaque de marbre ou d'airain. HOMERE comptoit autant ſur la durée des tombeaux

qu'il chantoit, que ſur l'immortalité de ſes tableaux: Τοῖς, οἳ νῦν γεγάασι, καὶ οἳ μετόπισθεν ἔσονται *.

Si ces preuves ſuffiſent, Meſſieurs, pour détruire tous vos doutes ſur l'exiſtence de ces précieux reſtes de l'antiquité, j'acquiers des droits à la même confiance de la part de tous les Savans; et je me plais à eſperer, que lorſque la Société Royale d'Edimbourg aura prononcé un jugement favorable ſur l'authenticité de ces monumens fameux, toutes les Académies de l'Europe s'empreſſeront de l'adopter, et que les voyageurs éclairés de toutes les nations, que leurs affaires ou leur curioſité, conduiront dans l'Helleſpont, ſe feront un devoir, de dedommager par un culte nouveau, les tombeaux des héros de l'Iliade, de l'oubli criminel dans lequel la barbarie les avoit plongés depuis tant de ſiècles.

* Odyſſ. xxiv. 84.

II.

N. B. The above Paper has been tranſlated into Engliſh, and accompanied with large Notes and Illuſtrations, by Mr Dalzel, Profeſſor of Greek in the Univerſity of Edinburgh; with the approbation of the Committee of Publication of this Society: And it has been printed in the ſame form with theſe Tranſactions, and publiſhed by T. Cadell, in the Strand, London; and W. Creech, Edinburgh. 1791.

II. *An* Essay *upon the* Utility *of* defining Synonymous Terms *in all Languages; with Illuſtrations by Examples from the Latin. By* John Hill, LL. D. F. R. S. Edin. *and Profeſſor of Humanity in the Univerſity of Edinburgh.*

[*Read by the Author, Feb.* 18. 1788.]

WORDS that are preciſely equivalent are rarely, if at all, to be met with in any language. Thoſe properly called *ſynonymous*, exhibit one leading circumſtance in which they all agree, and one or more acceſſory circumſtances in which they differ. When the point of their general coincidence, and the grounds of their particular diverſities, are clearly aſcertained, it is then in the power of the writer to uſe them with propriety. By the aſſiſtance of the grammarian, he knows which to adopt and which to reject, and can reconcile embelliſhment with accuracy and preciſion.

The excellence of any language may in a great meaſure be judged of, by the number of ſynonymous terms that belong to it. A multiplicity of them, under ſkilful management, creates no hurtful redundancy. On the contrary, it enables every author of taſte to exhibit his thoughts with energy and luſtre. For the moſt delicate variety of ſhades in thought, he is furniſhed with a correſponding variety in expreſſion; and the language in which he conveys his idea, becomes a complete picture of the idea itſelf.

The author of this eſſay is abundantly ſenſible, that though the Latin tongue preſents many claſſes of ſynonymous terms,

yet

yet to catch the circumſtance on which their differences reſt, is no eaſy matter, and may often leave room for diverſity of opinion. After a careful examination of the claſſical writers, he ſuſpects it will be found, that in the glow of compoſition, the ſtrict diſtinctions between ſuch words have not been always attended to, and that the pureſt writers have occaſionally deviated from the ſtandard which their general practice had eſtabliſhed. Still, however, he apprehends, that there is room for a critical and ſcientific diſcuſſion of the Latin ſynonymous terms. As this is a ſubject to which, in the line of his profeſſion, he was led to give particular attention, and as he conſiders it to be of no ſmall importance to thoſe who wiſh to diſcriminate the ſlighteſt violation of purity in the Roman language, he has made a very large collection of its ſynonymous words, with remarks upon them. The following ſpecimen of the inſtances he has collected, he ſubmits, with much diffidence, to this learned Society.

Rogare, petere, postulare, poscere, flagitare, agree in denoting the expreſſion of a deſire to obtain ſomething not poſſeſſed, but differ in reſpect to the urgency with which this deſire is announced. They are all diſtinguiſhed from the verbs *cupere* and *optare*, which, though not equivalent, ſuppoſe, like them, the exiſtence of deſire, but not the expreſſion of it, with a view to its being fulfilled.

The power of the verb *rogare* extends no farther than to the ſimple intimation of deſire. By means of it, a want is ſuggeſted to the perſon addreſſed, of which he was before ignorant, and both he and his petitioner are ſuppoſed conſcious, that compliance with the requeſt muſt be voluntary and the effect of good-will. " Moleſtum verbum eſt, et oneroſum, et demiſſo " vultu dicendum *rogo* *."—" Malo emere quam *rogare* †."

He

* Sen. Ben. 22.

† Cic. in Ver. 4. 12.

He who propofed a law in the Roman Comitia, and was then faid *rogare legem*, prefented his requeft refpectfully, and left it to the Affembly to judge as to the expediency of granting it.

Petere differs from *rogare*, in fuppofing a certain difficulty in coming at the object defired, and a greater degree of keennefs upon the part of the petitioner. "Ad te confugimus, a "te opem *petimus* *."—"Cum a me *peteret* et fumme conten-"deret, ut propinquum fuum defenderem †."—"Id fibi ut do-"naret, *rogare* et vehementer *petere* cœpit ‡." In the laft example, the verbs *rogare* and *petere* are evidently contrafted. The latter denotes a degree of zeal upon the part of the perfon who afks, which the former does not.

The definition now given of *petere* does not correfpond with that given by Servius. "*Petere*," fays he, "eft cum aliquid "humiliter, et cum precibus poftulamus §." With all the refpect due to fo great a critic, it may be urged, that this power of *petere* is not to be difcerned in the verb when taken by itfelf, though it may be expreffed by words with which it is occafionally accompanied. Thus, Cæsar, *De Bello Gallico*, fays, "Suppliciterque locuti, flentes pacem *petiffent*."—"Pueri "mulierefque, paffis manibus, pacem ab Romanis *petierunt* ‖." Nothing in either of thofe inftances ferves to prove, that the keennefs of the petitioner, which marks the verb, may not exift, independently of the manner in which the requeft is prefented. The manner is in fact expreffed by thofe terms that happen to be adjuncts to the verb.

Petere, from the Greek verb πετω, *ferri*, *volare*, fhews its native force in fuch derivatives as *impetus* and *præpes* **. It feems

* Cic. Tufc. Q. 5. 5. † Cic. Quin. 14. *a*. ‡ Cic. Ver. 215. *a*.
§ Æneid. 9. 193. ‖ 1. 27. & 2. 13.

** The obfervations of the celebrated Gesner upon this verb, are worthy of that extenfive erudition and acute difcernment for which he is juftly diftinguifhed. By means of his accurate remarks upon the force of fome fingle terms, my labour in tracing the circumftance by which they are allied to other ones, has been abridged; and no fcholar fhould be afhamed to avow his obligations to fo able a guide.

ſeems to have originally expreſſed an effort to come at objects not within reach, and to have been transferred from material objects to intellectual conceptions. Its primitive power appears in ſuch inſtances as the two following: "Sciebam CATILINAM "non latus aut ventrem, ſed caput et collum *petere* ſolere*."—"Malo me GALATÆA *petit*, laſciva puella†."

THE power of *petere*, thus limited, appears to have been afterward extended, ſo as to expreſs a deſire, accompanied with an effort to obtain any object whatever; and thus the original idea of bodily exertion was loſt in that of the eagerneſs of any purſuit. Candidates for offices at Rome were ſaid *petere magiſtratus;* and from a ſenſe of the value, as well as of the difficulty of obtaining the object, they were keen in the purſuit of it.

FROM a paſſage in HORACE, it ſhould ſeem, that any means for the acquiſition of an object that are leſs than coercive, may be expreſſed by the verb *petere*.

——— CÆSAR, qui cogere poſſet,
Si *peteret* per amicitiam patris atque ſuam, non
Quidquam proficeret‡.

Nothing more is ſuggeſted here by *petere*, than CÆSAR's keenneſs to hear this muſician perform. It were abſurd to ſuppoſe, that the Emperor, who poſſeſſed the power of compulſion, would ever ſtoop to beg the favour, according to SERVIUS, "humiliter et cum precibus."

POSTULARE differs from *petere*, in as far as it ſuggeſts neither keenneſs nor difficulty in the acquiſition of the object. Beſides the ſentiment of deſire, which is common to all the five verbs compared, the idea of claim, which is manifeſtly not inherent in either of the two former, is eſſential to *poſtulare*. Upon a proper limitation of this claim, however, a due apprehenſion of the power of the verb depends.

THE

* CIC. pro Muræn. 136. *b*. † VIRG. Ec. 3 64. ‡ HOR. S. I. 3, 4.

The diſtinctive character of *poſtulare* ſeems to reſt on the acknowledged reaſonableneſs of that which is demanded. "Geo-"metræ ſolent non omnia docere ſed *poſtulare*, ut quædam ſibi "concedantur, quo facilius quæ velint explicent *." When geometers require any conceſſion of thoſe they are about to inſtruct, they appeal to their reaſon, and tacitly bind themſelves to allow the validity of that which they require. The axiom again, which is an undeniable principle, carrying with itſelf its own proof, is not to be confounded with the poſtulate or entreated maxim. Other philoſophers, as well as mathematicians, eſtabliſh poſtulates, though often in terms leſs definite, and of courſe more readily miſtaken. "M. Daſne igitur hoc, "POMPONI, Deorum immortalium vi, natura, ratione, naturam "eam regi? A. Do ſane ſi *poſtulas* †."

CICERO uſes the expreſſion, "Impudenter *rogare*, impu-"dentiſſime *poſtulare* ‡;" and thus intimates, that the indecency which was culpable in the bare ſuggeſtion of a deſire, as implied in the former verb, roſe in a ſuperlative degree, when to this was ſuperadded the idea of a claim, as implied in the latter.

IT appears from QUINTUS CURTIUS, that the inſolence of DARIUS, after a ſevere defeat, provoked ALEXANDER. He not only took to himſelf the appellation of King, without giving it to his Conqueror, but preſented his requeſts in terms that became not his ſituation. The hiſtorian of ALEXANDER accordingly ſays, "*Poſtulabat* autem magis quam *petebat* §."

POSCERE agrees with *poſtulare*, in ſuppoſing, that the petitioner has a claim to have his requeſt granted; but it beſides denotes, that he himſelf is entitled to judge as to the validity of that claim, without regard to the opinion of the perſon requeſted, or to the acknowledged equity of the demand. Thus, CICERO

 ſays,

* CIC. de Off. 58. *b*.

† CIC. de Legg. 1. 7.

‡ CIC. de Off. 1. 88.

§ QUIN. CUR. 4. 1.

ſays, " Nemo tam audax qui *poſceret*, nemo tam impudens qui " *poſtularet* *." The pointed oppoſition made here by the orator between the two verbs, ſhews clearly the meaning affixed by him to each. Impudence, he tells us in the laſt clauſe, or a contempt for the opinion of the world, who would judge as to the propriety of the demand, is all that would be needful for enabling the petitioner to preſent it in the form denoted by *poſtulare*. With regard to *poſcere*, however, the caſe is different. A ſentiment of courage is ſuppoſed needful, when a petition, implying the violation of ſome private right, was to be preſented. A matter of favour would, with an unbecoming boldneſs, have been held forth as a matter of right, ſo that the perſon requeſted might reject the petition, as being an inſult to himſelf.

THE definition given by VARRO of *poſcere* ſeems perfectly juſt, except only in as far as a compound is prepoſterouſly taken to ſtate the power of the verb itſelf. " *Poſcere*," ſays he, " eſt quoties aliquid pro merito noſtro depoſcimus †." Had the critic taken the trouble previouſly to define " depoſcere," we ſhould have been at no loſs to underſtand his account of the ſimple verb. His definition appears to be, in other reſpects, complete, as he ſuppoſes the petitioner poſſeſſed of the power of meaſuring the extent of what he ſtyles " meritum."

THE different uſes of the verb *poſcere* may be all reconciled with the definition now given, when it is applied to the intercourſe that takes place between man and man. In its application, however, to thoſe petitions that were preſented by the ancients to their gods, its power becomes more myſterious. The idea of right is not eaſily reconciled with that of ſupplication; ſo that, according to the definition given of the verb, thoſe who were ſaid *poſcere deos veniam*, might well be accuſed of profaneneſs.

IN

* CIC. in Ver. 4. 44. † SERV. Æn. 9. 193.

In order to obviate this ſeeming objection, it muſt be remembered, that a difference of opinion reſpecting the ſame act in any two countries, may very naturally produce a difference in the interpretation of thoſe words, that are expreſſive of this act in each. Undefined terms have in this way become a fruitful ſource of controverſy in matters both civil and religious; and even the ſcience of grammar has ſuffered by thoſe inaccuracies of expreſſion, which it profeſſes to remedy in all other ſubjects. The religious ſentiments of the Romans were by no means refined. Vows were preſented as bribes to their deities, into whoſe ear they whiſpered petitions, which they were aſhamed to acknowledge in the face of the world. "Turpiſſima vota "diis inſuſurrant; ſi quis admoverit aurem, conticeſcent, et "quod ſcire hominem nolunt deo narrant *." The prayer of ſuch worſhippers, then, was a matter of traffic, not an act of devotion. That diſintereſted benevolence, in reliance upon which more pious ſupplicants preſent their requeſts, was none of the attributes of a Roman deity. The humiliation of the devotee was in his own eyes an article of merit; and he left the altar on which he had laid his offering, feeling the obligation impoſed on that being to whom it was preſented.

Many paſſages in the Latin claſſics confirm the truth of the obſervations now made.

——— non tu prece *poſcis* emaci,
Quæ niſi ſeductis nequeas committere divis †.

"Antequam limen Capitolii tangant, alius donum promittit, "ſi propinquum divitem extulerit, alius ſi theſaurum effoderit. "Ipſe Senatus recti bonique præceptor, mille pondo auri Capitolio "promittit. Omnibus diis hominibuſque formoſior videtur maſſa "auri, quam quicquid Apelles Phidiasve, Græculi delirantes

n 2 "fecerunt.

* Sen. Ep. 10.

† Pers. Sat. 2. 3.

" fecerunt *." — " Prisco instituto rebus divinis opera datur.
" Cum aliquid commendandum est, prece; cum solvendum,
" gratulatione; cum exposcendum, voto †." The vow then among the Romans was a bribe, the acceptance of which was deemed obligatory upon the party who took it. As means leading to an end, it necessarily preceded the claim, and was the foundation on which it was built.

The same notions respecting vows prevailed among the Greeks, as well as the Romans. In the prayer of the priest who had been affronted by AGAMEMNON, the Grecian bard makes him state his claim to be heard in the most express terms.

——— ει ποτε τοι χαριεντ' επι νηον ερεψα,
Η ει δη ποτε τοι κατα πιονα μηρι' εκηα
Ταυρων ηδ' αιγων, τοδε μοι κρηηνον εελδωρ ‡.

FLAGITARE differs from *postulare*, and agrees with *poscere*, in supposing the justness of the privilege assumed by the petitioner, of judging as to his own claim. Its power, however, is more extensive than that of *poscere*, because to the idea of being the judge of the validity of his right, it superadds that of effecting his purpose by such means as he reckons fit for doing so. In those means, at the same time, there may be a considerable variety. The petitioner may either distress the person requested with incessant importunity, or he may threaten vengeance, if the claim which he feels himself entitled to enforce is not fulfilled. That *flagitare* has more power than *rogare* and *postulare*, appears from the two following sentences: " Metuo
" ne te forte *flagitent*, ego autem mandavi ut *rogarent*."—" Ta-
" metsi causa *postulat*, tamen quia *postulat*, non *flagitat*, ego præ-
" teribo §."

IN

* Petron. Arbit. 88. 8.

† Val. Max. 1. 1. 1.

‡ ΙΛΙΑΔ. α. 39.

§ Cic. Ep. Fam. 98. et pro Quint. 13.

In the oration of Cicero for Plancius, he calls upon Laterensis to ſpecify his charge, and to mention any one tribe that his friend had corrupted in his competition for the Ædileſhip. "Etiam atque etiam inſto atque urgeo, inſector, *poſco* "atque adeo *flagito* crimen *." There is evidently a climax in the five verbs that compoſe this ſentence, and the gradation is very happily ſupported. By means of *poſcere*, the orator makes a requiſition in behalf of his client, of the juſtice of which he had a right to judge, and by the public manner in which this requiſition was made, he virtually threatens him with the penalties of law, if it was not complied with; which laſt conception is involved in the verb *flagitare*.

Ausonius Popma defines this verb very properly, "Vehementer et plerumque cum ſtrepitu et convicio *poſcere* †."

The gentleſt power of *flagitare*, which is that in which the petitioner propoſes to effect his purpoſe only by teazing, appears in ſuch examples as the two following: "Implorare et "*flagitare* auxilium Conſulis ‡."

——— nec potentem amicum
Largiora *flagito*,
Satis contentus unicis Sabinis §.

There are other inſtances again, in which *flagitare* implies, that the petitioner threatens the perſon requeſted, and excites fear, in order to effect his purpoſe.

Ejicite ex animo curam atque alienum æs,
Ne quis formidet *flagitatorem* ſuum ||.

"Petreius

* Cic. pro Plan. 48.
† De diff. Verb. lib. 2.
‡ Cic. pro Rab. 9.
§ Hor. Car. 2. 18. 12.
|| Plaut. Prol. Caſ. 23.

" PETREIUS atque AFRANIUS quum ſtipendum ab legionibus " pœne ſeditione facta *flagitarentur*, cujus illi diem nondum " veniſſe dicerent, CÆSAR ut cognoſceret *poſtulatum eſt* *." The requeſt made by the ſoldiers, in order to obtain their pay before it was due, was very different from that made to CÆSAR in order to have the matter ſettled.

THERE is a paſſage in TACITUS, in which the three laſt of the five verbs conſidered are ſo placed, that the meaning of each is very elegantly and deciſively brought forth. The hiſtorian is deſcribing the ſentiments both of OTHO and of the army at Bedriacum, which he had left juſt before the engagement that was to decide the conteſt between him and VITELLIUS. " Ibi " de prœlio dubitatum; OTHONE per literas *flagitante* ut ma- " turarent; militibus ut imperator pugnæ adeſſet *poſcentibus*; " plerique copias trans Padum agentes acciri *poſtulabant* †." By forming this anticlimax, TACITUS gives information to the grammarian which is worthy of his attention. The terms of the Emperor's meſſage, in which *flagitare* is uſed, are expreſſive of his authority, and intimate the danger of not complying with his requeſt. Thoſe which announce the ſentiments of the ſoldiers, by means of *poſcere*, are expreſſive of no unbecoming menace towards their commander, but make the fulfilment of their right to be led on to battle by him, the condition of their obedience. Many, again, whoſe requeſt is announced by *poſtulare*, ſuggeſt a reaſonable claim, in which there is not even the ſhadow of contumacy. They are willing to obey the orders of their commander with all prudent diſpatch, and even in his abſence, and they require a reinforcement, not as a right, but as the means of doing juſtice to their own courage, and to the cauſe which they had eſpouſed. The delicacy exhibited by the hiſtorian in this deſcription, will pleaſe the more the longer it is contemplated. He not only delights his

* Cæſ. Bell. Civ. 1. 87. † Tac. Hiſt. 2. 39.

his reader by an elegant and maſterly diſcrimination of the various ſentiments then prevalent in the minds of OTHO and his followers, but furniſhes him alſo with ſome curious grammatical facts, which few other writers had ingenuity to perceive.

DOCERE, ERUDIRE, INSTITUERE, IMBUERE, agree in denoting a change produced upon the mind by communication from others, but differ in reſpect, either to the ſtate of that mind to which the communication is made, or to the means employed in making it. *Docere*, which, according to VARRO, comes from *do*, ſignifies to give information to thoſe who need it, without reference to their previous knowledge, and is a correlative term in reſpect to *diſcere*. Thus, SENECA ſays, " Homines dum *docent*, *diſcunt* *."—" Itaque not facile eſt invenire qui quod ſciat ipſe, alteri non tradat. Ita non ſolum " ad *diſcendum* propenſi ſumus, verum etiam ad *docendum* †." That *docere* is applicable to all who receive inſtruction, whether ignorant, or in a certain degree previouſly inſtructed, appears from the following paſſages: " Quid nunc te Aſine literas " *doceam*? Non opus eſt verbis ſed fuſtibus ‡."

> Hoc quoque te manet, ut pueros elementa *docentem*,
> Occupet extremis in vicis balba ſenectus §.

In the paſſages now quoted, *docere* ſuppoſes the minds receiving the information to be completely ignorant; but in the three that follow, they appear to be in a ſtate directly contrary. " Et " *docebo* ſus (ut aiunt) oratorem eum, quem quum CATULUS " nuper audiſſet, fœnum alios aiebat eſſe oportere ‖."

> Plura recognoſces, pauca *docendus* eris **.

" Quid

* Epiſt. 7.
† Cic. de Fin. 104. *a.*
‡ Cic. in Piſ. 95. *a.*
§ Hor. Ep. 1. 20. 17.
‖ Cic. de Or. 2. 233.
** Ovid. Faſt. 4. 418.

" Quid eſt enim aut tam arrogans, quam, de religione, de rebus " divinis, ceremoniis ſacris, pontificum collegium *docere* co- " nari *."

Docere is almoſt the only one of the verbs mentioned, that is employed to denote information given as to an event, as well as the acquiſition of a new conception. " Cum interea ne li- " teras quidem ullas accepi, quæ me *docerent* quid ageres †."

Erudire, from *e* and *rudis*, differs from *docere*, in referring always to the rude ſtate of the perſon inſtructed, and to the gradual progreſs by which he becomes learned. No ſuch ex- preſſion as " ſus *erudio* oratorem," can exiſt, becauſe, when *docere* is thus uſed, it vilifies the ability of the teacher, and heightens the information of the ſcholar. When the Romans uſed the phraſe *ſus Minervam*, the conſtruction was to be com- pleted by *docere*, not by *erudire*. They only admitted in idea the poſſibility of adding one or a few facts to the ſtock of know- ledge, poſſeſſed by the goddeſs of learning.

The inſtances that follow ſhew clearly, that *erudire* conſtantly implies the abſence of information upon the part of the perſon to be inſtructed.

—— qui mollibus annis
In patrias artes *erudiendus* erat ‡.

" Inde puerum liberûm loco cœptum haberi, *erudirique* artibus " quibus ingenia ad magnæ fortunæ cultum excitantur §."— " Philoſophia omnium mater artium nihil aliud eſt quam do- " num inventum deorum. Hæc nos primum ad illorum cul- " tum, deinde ad jus hominum, quod ſitum eſt in generis hu- " mani ſocietate, tum ad modeſtiam magnitudinemque animi " *erudivit* ‖." In this laſt example, the progreſs of man, as the

* Cic. pro Dom. 219. *b.*

† Ep. 34. *a.*

‡ Ovid. Ep. 1. 112.

§ Liv. 1. 39.

‖ Cic. Tuſc. Q. 161. *b.*

the pupil of philofophy, is beautifully painted by *erudire* in its pureft fenfe.

There is no inconfiftency in *docere* and *erudire* appearing in one fentence, and being applied to the different degrees of proficiency made by thofe acquiring knowledge. "Neque folum "vivi atque præfentes ftudiofos difcendi *erudiunt* atque *docent*, "fed hoc idem etiam poft mortem monumentis literarum affe-"quuntur *." Sallust fays of Sylla, that he was "literis "Græcis, atque Latinis juxta, atque *doctiffime eruditus* †." Upon the principles laid down, this compounded expreffion will bear to be analyfed. The participle, it fhould feem, denotes, that he had been regularly inftructed in Greek and Roman literature, and the adverb, that the ftock of his knowledge was fuch, that few, if any, were able to add to it.

One inftance occurs in Cicero, in which *erudire* fignifies to inform as to an event which *docere* does often. "Obviæ mihi "velim fint literæ tuæ, quæ me *erudiant* de omni republica, ne "hofpes plane veniam ‡." This uncommon ufe of *erudire* feems to juftify the definition given of it. Cicero modeftly confeffes that ignorance of the affairs of the ftate, in confequence of his abfence, which is perfectly confiftent with the pure ufe of *erudire*, and which, when duly reprefented, his correfpondent was able to remove.

Instituere differs from the preceding verbs in denoting the firft ftep of a progrefs in teaching, and the communication of the elements of whatever is the ground of inftruction. The fimple verb *ftatuere*, in a figurative fenfe, denotes the determination to act, while the compound denotes the commencement of the action that had been refolved upon. It is only, however, as applied to teaching, that this verb can be held fynonymous with the reft of the fet. "Socrates jam fenex *inftitui* "lyra non erubefcebat §." The verb here evidently refers to

 the

* Cic. de Off. 31. *b.*

† Jug. 95.

‡ Cic. Ep. 24. *b.*

§ Quinctil. 1. 27.

the firſt leſſon in an art, of which the philoſopher was before utterly ignorant. " Suſceperas enim liberos non ſolum tibi, " ſed etiam patriæ. Eos *inſtituere*, atque *erudire* ad majorum " inſtituta atque civitatis diſciplinam, non ad tuas turpitudines " debuiſti *." *Inſtituere* here refers to the firſt ſtep in a proceſs, which *erudire* ſuppoſes to be carried on in the education of children. The arrangement of the verbs, however, may be reverſed, and each reſpectively applied to that particular ſtate of certain pupils with which it beſt accords. " Senectus ado- " leſcentes *docet*, *inſtituit*, ad omne officii munus inſtruit †."

IMBUERE differs from *inſtituere*, in denoting the inſtilment of ſentiments that fit the pupil for making progreſs in a particular line. It implies intention upon the part of the agent, like the former verbs, and ſuppoſes the means of inſtruction to operate without the conſciouſneſs of him who receives it. In its original application to material objects, it had denoted an affection of them in reſpect to colour, taſte, or ſmell, communicated by means of a fluid, and has been afterwards applied to the production of a mental diſpoſition or aptitude not eaſily to be deſtroyed. " APPIUM CLAUDIUM præfectum urbis relinquunt, " jam inde ab incunabulis *imbutum* odio tribunorum plebiſ- " que ‡."—" Ad hanc legem non *docti* ſed *facti*, non *inſtituti* " ſed *imbuti* ſumus §." *Facti* here ſuggeſts the purpoſe of the Creator in oppoſition to that of a teacher, at whatever time he might communicate his inſtructions, and *imbuti* the inſtilment of preparatory ſentiments, before any leſſon was given, as involved in the verb *inſtituere*.

IMBUERE does not always imply the complete abſence of information on any ſubject, but it uniformly implies an effect produced as the means tending to future improvement. " Sin " ſit is qui et doctrina mihi liberaliter *inſtitutus*, et aliquo " jam

* Cic. in Ver. 184. *a*.

† Cic. de Sen. 82. *b*.

‡ Liv. 4. 36.

§ Cic. pro Mil. 103. *a*.

"jam *imbutus* uſu *." *Inſtitutus* here denotes, that a good foundation had been laid upon which the ſcholar's progreſs reſts; and *imbutus*, that by habit he had acquired ſuch prediſpoſitions, as fit him to advance in that line of ſtudy which the orator chalks out.

When Horace ſtates the good qualities of a ſlave expoſed to ſale, he ſays he was

> Literulis Græcis *imbutus*, idoneus arti
> Cuilibet: argillâ quidvis imitaberis uda †.

Though the power of the diminutive in the noun falls properly on the participle, yet no ambiguity is thereby produced in reſpect to the meaning of *imbutus*. From the words that follow, it evidently implies, that the ſmattering of Greek literature acquired by the ſlave, fitted him for making further proficiency.

Errare, vagari, palari, agree in denoting the uncertainty of thoſe who have moved as to the point at which their motion is to terminate, but differ in reſpect, either to the ground of the uncertainty, or to the number of thoſe involved in it. *Errare* properly ſignifies to wander, or to deviate from the path leading to a certain point which it is propoſed to reach. It ſuppoſes, that both before and during the act of moving, an intention exiſted of coming to a certain place, but that this intention is fruſtrated from ignorance of the road that leads to it. "Quæ tot veſtigiis impreſſa, ut in his *errari* "non poſſit ‡."

> Paſſibus ambiguis fortuna volubilis *errat*,
> Et manet in nullo certa tenaxque loco §.

> ——— procul avius *erras* **.

O 2 "Maxime

* Cic. de Or. 123. *b*.
† Hor. Ep. 2. 2. 7.
‡ Cic. Ep. Fam. 5. 20.
§ Ov. Met. 3. 175.
** Lucret. 2. 739.

" Maxime vero mirabiles ſunt motus earum quinque ſtellarum, " quæ falſo vocantur *errantes* *." It is in this laſt example ſaid, that there is both deſign, and the power of fulfilling deſign, in the author of that ſeemingly irregular motion obſerved by the planets. *Errare* is applied to animals grazing. They direct their motion not in a ſtraight line, and may often miſs the beſt of the paſture they are in queſt of.

Mille meæ Siculis *errant* in montibus agnæ †.

—— armento teneras *errante* per herbas ‡.

Vagari differs from *errare* in implying, that the wanderer means only to quit the ſpot he occupies, and has no intention to direct his courſe to any particular place. The perſon *errans* commits a miſtake, which the perſon *vagans* never can, becauſe he has formed no plan that can be fruſtrated. " Non ſumus " ii quorum *vagetur* animus errore, nec habeat unquam quid " ſequatur §."—" Curandum eſt ne *vagum* villicum, nec aver- " ſum contubernio ſuo habeamus **."—" Nam fuit quoddam " tempus quum in agris homines paſſim beſtiarum more *vaga-* " *bantur* ††." Men, at the period referred to, were vagabonds, who, knowing no place more deſirable than another, continually changed their abode.

The following figurative acceptation of *errans* and *vagus* ſeems to confirm what has been ſaid of the verbs with which they are reſpectively connected. " Eſt enim et philoſophi, et pon- " tificis, et Cottæ, de diis immortalibus habere non *errantem* " et *vagam*, ut academici, ſed ut noſtri. ſtabilem certamque ſen- " tentiam ‡‡." In the antitheſis, *errans* is oppoſed to *ſtabilis*, and

* Cic. Nat. D. 36. *a.*

† Virg. Ec. 2. 21.

‡ Ov. Met. 15. 14.

§ Cic. Off. 34. *a.*

** Colum. 12. 1.

†† Cic. de Inv. 1. 2.

‡‡ Cic. Nat. D. 26. *a.*

and fuggefts, that the philofopher occupies a point at which he is difpofed to reft, without making any attempt to go to another, in which he might fail. *Vagus* again is oppofed to *certus*, and implies, that he is free from that want of determination as to the point he is to arrive at, which is peculiar to vagabonds.

PALARI agrees with *vagari*, in implying the act of roving without any fettled direction; but differs both from it and *errare*, in fuggefting the difperfion of a multitude and the ftraggling of fcattered parties. The two former verbs apply either to one or a number, and have no reference to any party with which they were previoufly connected. It is otherwife with *palari*; which fuppofes more than one feparated from a company that has been broken.

Fœmina *palantes* agit, atque hæc agmina vertit *?

" Teucrorum auxilia, fœda fugâ difperfa, totis campis *pa-*
" *lantur* †."

THE purity of the following expreffion in LUCRETIUS, in which *errare* and *palari* are found in the fame fentence, may be queftioned:

Defpicere unde alios queas paffimque videre
Errare, atque viam *palantes* quærere vitæ ‡.

The fame wanderers cannot be both with and without an object at the fame time. While *palari* then marks only their number and their difperfion, the terms " viam quærere vitæ" annexed to it fhew, that it is not to be underftood in its full extent.

MAGNUS

* Virg. Æn. 11. 736.
† Tacit. Hift. 4. 18.
‡ Lucret. 2. 9.

Magnus, ingens, amplus, procerus, agree in denoting the magnitude of objects, but differ in refpect either to its degree, or to the manner in which it is eftimated. The notion of abfolute magnitude, it muft be obferved, is inconceivable. Men have compared the object they denominate *great* with others of the fame kind with itfelf, and have given it its appellation from obferving its relative greatnefs. Thus, " magna balæna" fignifies either a whale that is larger than other animals of its own fpecies, or that, compared with other forts of fifhes, exceeds them in fize. As *magnus* relates to every kind of greatnefs, and embraces every object within that predicament, fo it may be regarded as the general term. " *Magna* dii curant, " parva negligunt *."

In the original application of *magnus* to material objects, it fignifies their greatnefs in refpect both to quantity and number.

Heu *magnum* alterius fruftra fpectabis acervum †!

" *Magnum* numerum frumenti pollicentur ‡." The mafs which in both the above examples is denominated *magnus*, receives this appellation, both from the fize of the whole, and from the number of its parts confidered feparately.

Magnus is figuratively applied to immaterial objects, and denotes a fuperiority in fome refpect among them, analogous to that of the largeft over the fmalleft material fubjects of a fpecies. " Si ut fapientibus placet, non cum corpore extinguun- " tur *magnæ* animæ §."

Magnum pauperies opprobrium jubet **.

Ingens differs from *magnus* in denoting a greatnefs that is preternatural, and is unexampled in the clafs of objects to which that

* Cic. N. D. 51. *b*.

† Virg. Geor. 1. 150.

‡ Cic. Ep. ad Att. 82. *a*.

§ Tac. Ag. 46.

** Hor. Car. 3. 24: 42.

that ſpecified belongs. It ſurpaſſes the power of *maximus*, the ſuperlative from *magnus*, as the latter marks the greateſt only among the objects of a ſpecies, in reſpect to a quality, which, though exiſting in different degrees in each, admits compariſon in all. The ſuperiority of that denominated *ingens*, again, is ſo decided, as to eclipſe the reſt that participate in its nature.

> Scilicet et fluvius qui non eſt *maximus*, ei eſt,
> Qui non ante aliquem *majorem* vidit : ——
> —— et omnia de genere omni,
> *Maxima* quæ vidit quiſque hæc *ingentia* fingit *.

> HE. Quid jubeam ? ER. Ignem *ingentem* fieri.
> HE. Ignem *ingentem?* ER. Ita dico *magnus*
> Ut ſit †.

INGENS agrees with *magnus* in admitting an application to objects, of which quantity is not an attribute.

> THRAS. *Magnas* vero agere gratias THAIS mihi ?
> GNATH. *Ingentes* ‡.

CICERO comments upon this paſſage in a way that puts the preciſe difference between the terms in the cleareſt light poſſible. " Satis erat reſpondere *magnas* : *ingentes* inquit. Semper " auget aſſentatio id, quod is, cujus ad voluntatem dicitur, vult " eſſe magnum §."

DURING the Auguſtan age, the proſe-writers never uſed degrees of compariſon from *ingens*. When VIRGIL ſtyles ÆNEAS " fama *ingens*, *ingentior* armis," his doing do muſt be conſidered as a poetical licence, ſuch as that of MILTON ſpeaking of the leviathan.

> *Hugeſt* of living creatures, in the deep
> Stretch'd like a promontory, ſleeps or ſwims,
> And ſeems a moving land.

THE

* Lucret. 6. 674.

† Plaut. Capt. 4. 2. 64.

‡ Ter. Eun. 3. 1. 1.

§ Cic. in Læl. 26.

The ſuperlative *ingentiſſimus* is not found but in ſuch writers as Symmachus and Vegetius, who lived late, and whoſe practice ſhould not be regarded as a ſtandard. The abſurdity, at the ſame time, is equal, in giving *ingens* either a comparative or a ſuperlative degree; as the eſſence of hugeneſs depends on there being nothing in nature in which the quality that it is made to denominate, is to be found in a ſuperior degree.

Amplus differs from *magnus* and *ingens*, in being limited to that kind of greatneſs among material objects which conſiſts in ſuperficial capacity. It properly denotes ſuch an extenſion of a ſurface as fits it for receiving what it is deſigned to contain. "In qua *ampliſſima* curia, *ampliſſimum* gymnaſium et complures "ædes ſacræ: coliturque ea pars et habitatur frequentiſſi-"me *."

Illos porticibus rex accipiebat in *amplis* †.

"Ad eam multitudinem urbs quoque *amplificanda* viſa eſt ‡." In this laſt example, the compounded verb marks the power of the adjective very diſtinctly. It denotes the neceſſary extenſion of the precincts of the city, ſo as to afford commodious habitations for the growing multitude. "Loci præter modum "*ampli* vagas imagines reddunt, et nimis anguſti ſæpe non vi-"dentur poſſe capere imaginum collocationem §."

Amplus, like the two words defined, is often transferred from material to immaterial objects. "Suoſque omnes per ſe "eſſe *ampliores* volebat **."

Procerus differs from all the words ſtated, in never being transferred from material to immaterial objects, and in imply-ing,

* Cic. in Ver. 228. *a.*

† Virg. Æn. 3. 353.

‡ Liv. 1. 44.

§ Auct. ad Her. 22. *a.*

** Cic. Am. 109. *a.*

ing, that the magnitude is eftimated, not from the extenfion of the object in all the directions that can take place on a furface, but in that of a ftraight line, that is either perpendicular or horizontal, according to the nature of the object fpecified. Applied to the human form and to trees, it denotes tallnefs; and to fifhes and four footed animals in their natural pofition, length. The general proportions in each, at the fame time, are underftood to fubfift, according to the law obferved in the reft of their kind. "Gallorum quifque *proceriffimus* ad pompam "triumphi lectus *."—"Sues *procero* corpore, capitibus ut fint "parvis †."

> *Proceras* manibus vertere fraxinos ‡.

> ——— quo pertinet ergo
> *Proceros* odiffe lupos? quia fcilicet illis
> Majorem natura modum dedit, his breve pondus §.

HUMIDUS, UVIDUS, MADIDUS, agree in denoting the quality of wetnefs, but differ as to the manner in which it is generated and retained. *Humidus* implies, that the object which it fpecifies not only contains moifture, but is fitted to fupply the wafte of it, whether by evaporation or otherwife. It comes from *humor*, and that from *humus*, and regards the ground as furnifhing a conftant fupply to thofe fprings which break forth at different parts of its furface. "Præmiffo Cecina ut occulta "faltuum pontefque et aggeres, *humido* paludum, et fallacibus "campis imponeret **." *Humidus* then, in its primitive fenfe, refers to a fubject as formed by the hand of nature, and poffeffed of a quality which, when abfent, cannot be imparted, and when prefent, cannot be deftroyed.

* Sueton. Calig. 47.
† Var. de Re. R. 2. 1.
‡ Hor. Car. 3. 25. 16.
§ Hor. Sat. 2. 2. 35.
** Tac. Ann. 1. 61.

The definition given by Servius of *humidus*, ſeems to have been very properly rejected by Ausonius Popma, whoſe remarks " de differentiis verborum," are often both ingenious and ſolid. " *Humidum*," ſays Servius, " quod extrinſecus " habet aliquid humoris * ;" to which Popma refuſes to aſſent, " Cui non adſentior. *Humidum* enim proprie eſt quod in pro- " fundo continet humiditatem, ut terra †."

Humidus is transferred from the ſubject to which, from its etymology, it appears to have been originally applied, to others that ſtrongly reſemble it. Thus, Virgil ſpeaks of the " humida " nox," and means by it that dampneſs which prevails in the air, next the ſurface of the earth, from the conſtant falling of the dew in the courſe of the night. It is transferred by Ovid to the clouds, and by Vitruvius to thoſe winds which ordinarily produce rain.

> —— cadit Eurus et *humida* ſurgunt
> Nubila ‡.

" Auſter et reliqui (venti) qui a ſolis curſu ſunt *humidiſſimi* §."

In both thoſe applications of the word, there is a reference to a ſupply of the waſte, and of courſe to the long continuance of the fall expected.

Humidus is occaſionally applied to bodies impregnated with moiſture, which they receive from others that generated it. Cicero ſpeaks thus of a bed bedewed with tears, " Qui " jacet in lecto *humido*,

> Ejulatu, queſtu, gemitu, fremitibus,
> Reſonando, multum flebiles voces refert **.

The

* In Virg. Ec. 10. 20.

† Lib. 2. 133.

‡ Virg. Æn. 3. 198.

§ Vitruv. 8. 21.

** Cic. Tuſc. 9. 2. 33.

The wood of a tree, too, when vegetating, may be ſtyled *humidus*, on account of the communicated moiſture which ſupports it. Nay, CICERO, in one inſtance, applies the term to wood that is green and newly cut. "Ignem ex lignis viridibus atque *humidis* in loco anguſto fieri juſſit *."

UVIDUS agrees with *humidus*, in ſuppoſing, that the ſubſtance to which it is applied contains moiſture, but does not ſuggeſt the means of ſupplying the waſte, from whatever cauſe it ariſes. The definition given by SERVIUS of this term is more accurate and ſatisfactory than that given of *humidus*. It were better, at the ſame time, not to derive *uva* from *uvidus*, but to conſider the ſhorteſt of the two words as the root. "*Uvidum* eſt," ſays he, "quod intrinſecus habet aliquod humoris, unde uvæ dicuntur †."

> Arboribus redeunt detonſæ frigore frondes,
> *Uvida*que in gravido palmite gemma tumet ‡.

THE hand of art, it may be obſerved, can operate in the deſtruction of the quality denoted by *uvidus*. A grape may loſe its juice by its being expreſſed, or by a forced evaporation ſuperinduced by heat, ſo as to avoid putrefaction in the ſubſtance containing it. When the ſucculent quality is deſtroyed completely, the ſubſtance left behind quits both the natural tenacity of its parts, and the flavour which diſtinguiſhed the fruit, and gets into the ſtate denoted by *aridus*. When this quality is removed by an intended evaporation, it is removed only in part. Such a quantity of the juice is retained as is conſiſtent with the preſervation of the fruit, and as will emit its flavour. The ſubſtance is then in the ſtate denoted by the

p 2 adjective

* Cic. in Ver. 2. 45.

† In Virg. Ec. 10. 20.

‡ Ovid. Faſt. 4. 235.

adjective *ſiccus*, which implies no tendency towards decay. "Ne "ſint fragilia et *arida* potius quam *ſicca* folia *."

The abſtract noun *ſiccitas* is occaſionally taken to denote the firmneſs of the fleſh, and of courſe the ſtrength of an animal. It implies a quality oppoſite to what is meant by flaccid, or being without due tenſion, and ſuppoſes this quality to ariſe from the natural juices neither being in a ſuperabundant nor a deficient ſtate. Thus, CICERO, talking of the wonderful ſtrength of MASINISSA when at the age of ninety years, ſays of him, "Nullo imbre, nullo frigore adduci, ut capite operto ſit: ſum-"mam in eo eſſe corporis *ſiccitatem* †."

SOME very ſubtle obſervations of ARISTOTLE ſeem to juſtify what has been ſaid of *humidus*, *aridus* and *ſiccus*, and will throw light on what is afterwards to be ſaid of *madidus*. *Κρανρον γαρ, το τελεως ξηρον, ὡςε και πεπηγεναι δι' ελλειψιν ὑγροτητος. —αντικειται γαρ τῳ ξηρῳ και το ὑγρον και το διερον—και διερον μεν εςι το εχον αλλοτριαν ὑγροτητα επιπολης· βεβρεγμενον δε το εις βαθος· ξηρον δε, το εςερημενον ταυτης—ὑγρον μεν γαρ εςι, το εχον οικειαν ὑγροτητα εν τῳ βαθει.*—"Aridum enim eſt quod omnino ſiccum eſt, adeo "ut humiditate deficiente corpus etiam concreverit. Adverſa-"tur ſicco humidum et madidum. Madidum enim eſt quod "habet humiditatem non a ſe ortam, ſuperficie tenus. Humi-"dum vero quod introrſus habet; Siccum autem quod hac va-"cat. Humidum enim eſt quod in penitiore parte propriam "continet humiditatem ‡."

THE term *uvidus* is applied to the earth as well as *humidus*, but the quality ſuggeſted by it is different. Thus, COLUMELLA ſays, "Niſi præpingui et *uvida* terra §." By *uvida*, he does not mean the poor ſoil that is ſwampy, and generates water which it emits at its ſurface, but ſuch as, though moiſt, is rich and loamy.

UVIDUS is transferred from thoſe vegetable ſubſtances to which it is originally applicable, to others which ſtrongly reſemble them, by imbibing and retaining a quantity of moiſture.

—me

* Plin. 12. 12. 26.

† Cic. de Sen. 10. 83. *b*.

‡ Αριστοτ. περι γενεσεως και φθορας. κεφ. β.

§ Lib. 7. cap. 3.

—— me tabula ſacer
Votiva paries indicat *uvida,*
Suſpendiſſe potenti
Veſtimenta maris deo *.

The mariner's clothes hung up in the temple of NEPTUNE are here ſuppoſed to have been ſoaked in the ſea, and, like the grape, to contain a quantity of moiſture, which would either free itſelf by evaporation, or might be eaſily wrung from them.

Uvidus hiberna venit de glande Menalcas †.

Longas O utinam, Dux bone, ferias
Præſtes Heſperiæ, dicimus integro
Sicci mane die: dicimus *uvidi,*
Cum ſol oceano ſubeſt ‡.

In the laſt of the above examples, it appears, that *uvidus* differs from *humidus,* in being applied to mind, as well as matter, and in ſuggeſting the notion of drunkenneſs. This application ſeems to be founded on the kind of the drink which produces the intoxication. The amplificative adjective "vinoſus," denotes the quality of being a lover of wine, and *uvidus* as taken in the paſſage laſt quoted, denotes having drunk it plentifully, and feeling its effects.

MADIDUS differs from *humidus* and *uvidus,* in expreſſing moiſture that is not contained in the ſubſtance ſpecified, but which is adventitious, and affects its ſurface. It agrees alſo with the laſt term, in ſuppoſing it void of the capacity of ſupplying the waſte of moiſture, in whatever way that waſte may be effected. It applies to the extrinſic or ſuperficial wetneſs of a ſubſtance, whether this is produced by a natural or an artificial cauſe.

* Hor. Car. 1. 5. 14.
† Virg. Ec. 10. 20.
‡ Hor. Car. 4. 5. 37.

caufe. In the primitive and literal applications of *humidus* and *uvidus*, they denote fubjects furnifhed by the hand of nature with the attributes they refpectively denote. Thus, moifture is naturally inherent in humid ground and in a ripe grape. Drynefs, again, is the natural ftate of that which, being accidentally wet, is then faid to be *madidus*.

—— nam dum fe continet Aufter,
Dum fedet et ficcat *madidas* in carcere pennas,
Contemnunt mediam temeraria lina Charybdin *.

" Sed ille fcripfit ad BALBUM illum fafciculum epiftolarum totum " fibi aqua *madidum* redditum effe †." This packet was fo much wetted from an accidental caufe, that CICERO tells us the letter addreffed to him was not legible. A fuperficial wetting would produce this effect. It is not neceffary to fuppofe, that the *fafciculus* would be drenched like the *veftis uvida* before mentioned, which, from the porousnefs of the materials, had abforbed a quantity of water, and retained it as the fkin of the grape does its juice.

MADIDUS agrees with *uvidus*, in being applied to perfons as well as to things, and in fuggefting the idea of drunkennefs. He who was faid *madere vino*, was underftood to be " vino riga- " tus," that is, bedewed with wine.

Faciam ut fit *madidus* fobrius ‡.

The wit of the comic poet here refts upon his apprehenfion, that *madidus* refers to an external or fuperficial wetting in its primitive fenfe.

WHILE

* Juv. Sat. 5. 98.

† Cic. ad Quint. Frat. 2. 14.

‡ Plaut. Amph. 3. 4. 18.

WHILE *madidus* agrees with *uvidus* in the reſpect juſt mentioned, it differs from it in denoting proficiency in ſcience and in letters.

> Si quis Cecropiæ *madidus* Latiæque MINERVÆ
> Artibus, et vera ſimplicitate bonus *.

> Non ille quanquam SOCRATICIS *madet*
> Sermonibus te negliget horridus.
> Narratur et priſci CATONIS,
> Sæpe mero caluiſſe virtus †.

The critics have very properly explained *madidus* and *madere*, in the above and other ſuch paſſages, by means of the term *imbutus*. Both the adjective and the verb refer to a veſſel tinctured in reſpect to colour, taſte, or ſmell, by a fluid with which it was wet when made to contain it.

COMMODUS, OPPORTUNUS, TEMPESTIVUS, agree in denoting the ſuitableneſs of objects or events to thoſe intereſted in their nature, but differ in reſpect to the circumſtances upon which that quality is founded. The firſt comes from *con* and *modus*, and denotes, that the thing ſpecified is neither more nor leſs than it ſhould be, and poſſeſſes an inherent aptitude for ſome purpoſe to which it is juſt adequate. In the original application of *commodus*, it denotes the agreement of things as being adjuſted by one common ſtandard. Thus, when HORACE ſays,

> Miſcentur cyathis pocula *commodis* ‡,

he means, that thoſe "cyathi" were neither more nor leſs than they ſhould be. In conſequence of this equality, each gueſt got

* Martial. 1. 40.
† Hor. Car. 3. 21. 9.
‡ Car. 3. 19. 12.

got that ſhare of the wine which was, on the one hand, ſufficient to excite his vivacity, without producing, on the other, too quick an intoxication. When PLAUTUS alſo ſays,

Viginti argenti *commodas* minas *,

he means, that the pieces were of a regulated weight.

WHEN *commodus* is applied to perſons, it denotes their agreeableneſs as companions. It implies a mental temperament, which is mild from the reſtraint of ſentiments, that always give diſguſt when extravagant. It accordingly ſignifies that pliancy of character which, without ſervility, endears a perſon to thoſe with whom he lives. " Nemo CATONE proavo tuo " *commodior*, comior, moderatior fuit ad omnem rationem hu" manitatis †."—" Qui antea *commodis* fuerunt moribus, eos " proſperis rebus immutari ‡."

WHEN *commodus* is applied to events, it denotes, that they are agreeable, as being commenſurate to the wiſhes of thoſe concerned in their occurrence. It regards that medium, the happineſs of which would be deſtroyed either by defect or exceſs. " Nihil poteſt fieri nec *commodius* nec aptius, quam ut " ſcribis. Ex literis tuis, ea quæ in agro Piceno geſta ſunt cog" novi *commodiora* eſſe multo, quam ut erat nobis nunciatum §."

OPPORTUNUS differs from *commodus*, in having no natural reference to the adjuſted quantity of that which is ſpecified, and in regarding the ſuitableneſs as founded on the exigency or preſſing neceſſities of thoſe to whom the objects or events preſent themſelves. It comes from *ob* and *portus*, and its force reſts on the agreeableneſs of any harbour to a mariner when contending with a ſtorm. The ſuitableneſs implied in *opportunus* may

* Aſin. 3. 3. 135.

† Cic. pro Muræn. 66.

‡ Cic. Am. 106. *b.*

§ Cic. Ep. Att. 13. 37. & 126. *a.*

may be diſcerned either between objects and objects, or between events and the times and places of their occurrence.

> Nihil homini amico eſt *opportuno* amicius *.

" Ceteræ res quæ expetuntur *opportunæ* ſunt ſingulæ rebus fere " ſingulis : divitiæ ut utare : opes ut colare : honores ut lau- " dere : voluptates ut gaudeas †." In the firſt of the above examples, the friend may preſent himſelf either accidentally, or in conſequence of being ſought for ; in the laſt, the different things mentioned are all the objects of an intended and a keen ſearch. Both examples imply, that the occurrence or the attainments are highly ſeaſonable, from the circumſtances of the perſon concerned. " Ad hoſce proferendos, et tempus et " locum *opportuniſſimum* elegi ‡." In this laſt example, we ſee the ſuitableneſs between the event and both the time and the place of its occurrence.

TEMPESTIVUS denotes the ſuitableneſs of objects and events from neither of the circumſtances already mentioned, but from the former being in their ſtate of full maturity, and the latter occurring at their proper ſeaſon. As applied to objects, *tempeſtivus* ſuppoſes them belonging either to the animal or the vegetable kingdom, and of courſe having a progreſs toward perfection, and afterwards a decline. " Vindemia *tempeſtiva* §."

> Aut *tempeſtivam* ſylvis evertere pinum **.

> Tandem deſine matrem,
> *Tempeſtiva* ſequi viro ††.

 WHEN

* Plaut. Epid. 3. 3. 44.
† Cic. de Am. 100. *a*.
‡ Plin. lib. 8.
§ Colum. 11. 12.
** Virg. G. 1. 256.
†† Hor. Car. 1. 23. 11.

When *tempestivus* is applied to events, it supposes them either as returning in a regular vicissitude, or as happening at their proper period, and of course being well-timed. "Quam "*tempestivos* autem dedit, quam salutares non modo hominum, "sed etiam pecudum generi, iis denique omnibus quæ oriun-"tur ex terra, ventos etesios? Quorum flatu nimii temperantur "calores *."—"Ego vero propter sermonis delectationem *tem-"pestivis* quoque conviviis delector †."

Et *tempestivum* pueris concedere ludum ‡.

Navis, ratis, cymba, scapha, linter, agree in denoting a machine for conveying both persons and the subjects of trade by water from one place to another, but differ in respect to the size or the construction of that species, to which each can be properly applied. The first indeed is a generic term, applicable to a vessel of any kind, of whatever dimensions, or however formed.

Navem agere ignarus *navis* timet §.

The poet has here no intention to specify the kind of ship, as the danger from ignorance is the same in all kinds. "Confi-"cit optime cursum *navis*, quæ scientissimo gubernatore uti-"tur **."

The generality of the term *navis* is often limited by the application of adjectives, which mark the use of particular species; as, *Navis longa*, *marina*, *fluviatilis*, *piscatoria*, *oneraria*, *actuaria*, &c.

Ratis differs from *navis* in denoting the rudest vehicle to which a person can commit himself on water. The poets sometimes

* Cic. N. D. 52. *b.*
† Cic. de Sen. 14.
‡ Hor. Ep. 2. 2. 142.
§ Hor. Ep. 2. 1. 114.
** Cic. in Ver. 244. *b.*

times uſe *ratis* as a general term, but the proſe-writers never do. The term expreſſes a raft, formed by the junction of a few beams, which can be uſed with ſafety only in ſmooth water. It had at firſt been but a floating platform, and when improved a little, got the appellation of *cava*.

Ipſa vides cœlum pice nigrius et freta ventis
Turbida, perque *cavas* vix adeunda *rates* *.

Both Festus and Isidorus ſupport the account now given of *ratis*. " *Rates* vocantur tigna inter ſe colligata, quæ per " aquas agantur."—" *Rates* primum et antiquiſſimum genus " navigii e rudibus tignis aſſeribuſque conſertum."

In the two following inſtances, Cicero and Livy ſeem to juſtify the diſtinction made between *navis* and *ratis*. " Cum aut " *navibus* aut *ratibus* conarentur accedere †."—" *Navibus* ab " Hannibale incenſis, *rates* ad trajiciendum in magna inopia " materiæ ægre comparabat ‡." When any reference is made to *ratis* as the ſubject of a ſimile, it is always regarded as denoting a rude veſſel, capable of giving but very imperfect ſecurity. " Tanquam *ratis* in mari immenſo, noſtra vehitur " oratio §."

Cymba differs from *ratis*, in referring to a veſſel fabricated with more art, and that is always of a ſmall ſize. It denotes a boat, ſuch as is uſed upon a ferry or lake, but ſo formed as to give all the ſecurity to be expected from its dimenſions.

Non ideo debet pelago ſe credere, ſi qua
Audet in exiguo ludere *cymba* lacu **.

q 2 Cymba

* Ov. Ep. 17. 7.
† Cic. in Ver. 236. *b.*
‡ Liv. cap. 36.
§ Cic. Tuſc. Q. 164. *a.*
** Ovid. Triſt. 2. 329.

CYMBA is often applied to the boat in which CHARON wafted the ſouls of the dead acroſs the Stygian lake.

Scandenda eſt torvi publica *cymba* ſenis *.

This boat, we are told by VIRGIL, was ſo ſmall, that it could hardly ſupport the body of ÆNEAS.

—— gemuit ſub pondere *cymba* †.

SCAPHA differs from *cymba* in denoting a yawl that attends a ſhip for the convenience of thoſe who belong to it. As coming from the Greek verb σκαπτειν, it ſeems originally to have ſignified a canoe, or boat formed out of the trunk of a tree; but the circumſtance which diſtinguiſhes it, is that above mentioned. " Ut dominus navis cum idem gubernator eſſet in " *ſcapham* confugeret, et inde funiculo qui a puppi religatus " *ſcapham* annexam trahebat, navim quoad poſſet moderare- " tur ‡."—" Quum merſiſſent quaſſas naves in alto, exceptis " in præparatas *ſcaphas* nautis §."

LINTER differs from *ſcapha*, in implying no connection between it and a larger veſſel, and in denoting a " navis fluviati- " lis," or wherry uſed only on freſh water, ſuch as that of rivers and lakes. They agree as to the original mode of their formation, that is, as being μονοξυλα, or hollowed out of a ſolid piece of wood.

——— durum procudit arator
Vomeris obtuſi dentem, cavat arbore *lintres* **.

Partitur *lintres* exercitus; Actia pugna
Te duce per pueros hoſtili more refertur,
Adverſarius eſt frater, lacus Adria ††.

" Qui

* Propert. 3. 18. 24.
† Æn. 6. 413.
‡ Cic. de Inv. 81. *b*.
§ Liv. 23. 3.
** Virg. Georg. 1. 261.
†† Hor. Ep. 1. 18. 61.

" Qui cum non impetrasset, ut insulam in lacu prœlio vende-
" ret, repente *lintribus* in eam insulam, materiam, calcem, cæ-
" menta atque arenam convexit *."

COMES, SATELLES, SOCIUS, SODALIS, agree in denoting a connection that subsists between one person and either one or a number, but differ as to the end for which this connection is formed, and the conditions upon which it is maintained. *Comes* is properly applied to one who voluntarily gives his attendance to another as to his superior. That parity which subsists between a number of *comites*, does by no means take place between them and their patron. Reciprocal obligations are understood to subsist between the parties, but the duties vary according to the respective situations of each. The attendance of the *comites* is supposed to be given at all times, but especially when the superior is moving from one place to another, and the attachment of his followers is roused by a sense of his danger.

—— tibi parvula res est
Arcta decet sanum *comitem* toga †.

" CREUSA matre, Ilio incolumi, natus, *comes*que inde paternæ
" fugæ ‡."—" Quanta illi in oratione majestas ? Ut facile Du-
" cem populi Romani non *comitem* diceres §."—" Non enim
" paruit ille TIBERII GRACCHI temeritati, sed præfuit: nec se
" *comitem* illius furoris, sed ducem præbuit **."

SATELLES differs from *comes* in implying, that the difference of rank is greater between the superior and his attendants ; that the latter do not necessarily act from affection, and give their attendance as the instruments of protection or pageantry, or of both.

Aurum per medios ire *satellites*
Amat—— ††.

" Janitores

* Cic. pro Mil. 27.
† Hor. Ep. 1. 18. 29.
‡ Liv. 1. 3.
§ Cic. Amicit. 113. *b.*
** Cic. ibid. 103. *b.*
†† Hor. Car. 3. 16. 9.

" Janitores ducentos in annos ſingulos ſtipatores corporis con-
" ſtituit, eoſdem miniſtros et *ſatellites* poteſtatis *."

Socius differs from the two former words in implying, that parity of rank ſubſiſts between the parties, and that each has an equal right to enjoy the good that belongs to their common concern, and is under an equal obligation to take a ſhare of its evils. The *ſocius* is actuated, not by reſpect to a ſuperior, but by love to a party, in the ſucceſs of which he feels that he has an intereſt. " Nam *ſocii* putandi quos inter res communicata " eſt †."—" Sed me movet unus vir, cujus fugientis *comes*, " rempublicam recuperantis *ſocius* videor eſſe debere ‡." The ſentiment of reſpectful affection expreſſed towards the fugitive in adverſe times, is held the foundation of a claim to become his ally in times that were proſperous.

It is to be obſerved, that the perſonal attendance neceſſary to preſerve the relation between *comites* and *ſatellites*, and thoſe with whom they are reſpectively connected, may be diſpenſed with in the caſe of *ſocii*. When the terms of the alliance are defined, any mode of communication is ſufficient to maintain it. The ſame perſons, too, may, at the ſame time, be conſidered both as *ſocii* and *comites*. In the one caſe, they are regarded as having a common fate with their leader, and in the other, as aſſociating with their friend in a common adventure. Thus, Teucer is made to addreſs his *comites*, or followers, by the endearing appellation of *ſocii* alſo.

Quo nos cunque feret melior fortuna parente
Ibimus, O *ſocii comiteſ*que §.

Sodalis agrees with *ſocius* in ſuppoſing thoſe connected to be upon an equal footing, but differs from it in reſpect to the

* Cic. Rull. 72. *b.*

† Cic. Ver. 3. 50.

‡ Cic. Ep. Att. 132. *a.*

§ Hor. Car. 1. 7. 25.

the principle leading to the aſſociation, and to the purpoſe of maintaining it. Men become *ſodales*, not to promote their intereſt, but to enjoy ſociety. Their alliance is formed and preſerved for their mutual entertainment; it is never underſtood to lead to any thing diſagreeable, and it may at any time be abandoned without the violation of compact. "Et tempeſtiva "convivia, et pervigiles ludos, advocata *ſodalium* turba, ſolutus "atque affluens agerem *."

POMPEI meorum prime *ſodalium*,
Cum quo morantem ſæpe diem mero
Fregi ——— †.

"Primum habui ſemper *ſodales*. Epulabar cum *ſodalibus* om- "nino modice ‡."

COPIA, ABUNDANTIA, UBERTAS, agree in denoting plenty, but differ according as this refers to the removal of every want, to what is more than ſufficient for this purpoſe, or to the regular ſupply of a neceſſary waſte. *Copia*, which ſeems to be compounded of *con* and *opes*, denotes an aſſemblage of the means fit for effecting any purpoſe. It ſtands oppoſed to *inopia*, which denotes the abſence of ſuch means, and which is alſo derived from the ſame root. "Nec in ſumma *inopia* levis eſſe "ſenectus poteſt ne ſapienti quidem, nec in ſumma *copia* inſi- "pienti non gravis §." — "Rerum *copia* verborum *copiam* "gignit **."

——— obnoxii ambo
Vobis ſumus propter hanc rem, cum quæ volumus nos
Copia eſt, ea facitis nos compotes —— ††.

The

* Quinct. Decl. 9. 10.
† Hor. Car. 2. 7. 5.
‡ Cic. Sen. 86. *a*.
§ Cic. de Sen. 78. *b*.
** Cic. Or. 3. 123.
†† Plaut. Cap. 2. 1. 21.

The obligation mentioned in this laſt example reſts upon the complete ſupply afforded in reſpect to the object deſired. It muſt not, at the ſame time, be underſtood, that the ſupply denoted by *copia*, is always much more than adequate to the exigency. The term cannot be applied where there is any want, but it occupies all the interval between the mere abſence of this and that exuberance, which ſuggeſts a quantity more than adequate to any poſſible demand. " *Minimam copiam* poetarum " egregiorum extitiſſe *." Though there was no want of diſtinguiſhed poets at the period referred to, yet there was the ſmalleſt number to which *copia* could be applied. " Ex *majore copia* nobis " quam illi fuit eligendi poteſtas †." The *major copia* is here oppoſed to the *minor*, and the exiſtence of that latitude clearly proved, in which it has been ſaid that the ſubſtantive is taken. In the one caſe, *copia* denotes what miniſters to the gratification of the caprice, and in the other, to the full ſupply of the wants of mankind.

ABUNDANTIA differs from *copia*, in denoting greater plenty, and in implying that the object to which it is aſcribed, poſſeſſes more than ſufficient means for ſatisfying any want. It comes from *ab* and *unda*, and has at firſt referred to a river when overflowing its banks.

> Præſertim incertis ſi menſibus, amnis *abundans*
> Exit, et obducto late tenet omnia limo ‡.

" Circumfluere omnibus *copiis* atque in omnium rerum *abun-* " *dantia* vivere §." In the climax formed in this ſentence, the laſt ſubſtantive denotes ſomething beyond the ſatisfaction of want. It expreſſes ſomewhat to ſpare, which would be loſt if not uſed. " Non erat *abundans*, non inops tamen **. CICERO here

* Cic. de Or. 85. *b.*
‡ Cic. de Inv. 62. *b.*
‡ Virg. Georg. 1. 115.
§ Cic. de Am. 52.
** Cic. in Brut. 238.

here ſuggeſts the exiſtence of that interval, in all the different points of which *copia* finds a place. There is ſaid to be on the one hand nothing ſuperfluous, and on the other nothing deficient.

While *abundantia* denotes a greater plenty than *copia*, yet that implied even in it, may be occaſionally carried to exceſs, and to what in Engliſh is ſtyled "ſuperabundance," when the quantity is ſo great, as to be cumberſome and uſeleſs. "Ludos et inania honoris modo rationis atque *abundantiæ* "duxit, uti longe a luxuria ita famæ propior *." In the conduct of Agricola, there was on the one hand no blameable œconomy, and on the other no needleſs waſte, that might be termed extravagance. "Non illa quidem *luxurioſi* hominis ſed "*abundantis* †."

Ubertas differs from the two former words, in referring, not to the abſolute quantity alone exiſting at a ſpecified time, but to the regular ſupply of a neceſſary waſte, and in ſuppoſing the plenty denoted by all the terms uniformly continued. The adjective *uber*, of which it is an abſtract, takes its power from the ſubſtantive *uber*, ſignifying that which contains the milk of an animal giving ſuck. "Nuper nati mammas appe-"tunt, earumque *ubertate* ſaturantur ‡." From denoting the regular ſupply of this juice, deſigned for ſupporting the young of animals, it has been transferred to another operation of nature, viſible in the fertility of fields and trees. "*Ubertatem* "frugum et fructuum a diis ſe habere §."—"Facile eſt reme-"dium *ubertatis*, ſterilia nullo labore vincuntur **."

Last of all, *ubertas* has been figuratively applied to that inexhauſtible ſtore of ſentiment and expreſſion which forms a di-

* Tac. Agric. 6.

† Cic. Phil. 2. 66.

‡ Cic. de N. D. 52. *a.*

§ Cic. de N. D. 77. *b.*

** Quinct. 2. 4.

ſtinguiſhed orator; and in the example ſubjoined, the metaphor begun in the firſt member of the ſentence, is happily ſupported in ſome of the words that follow. "Omnis enim *ubertas*, et "quaſi *ſylva dicendi* ducta ab academicis eſt *."

* Cic. Orat. 198. *a*.

III. *On the* ANCIENT HELLENES. *By* DAVID DOIG, LL. D. F. S. S. A. *and Maſter of the Grammar School at Stirling.*

[*Read Nov.* 15. 1790, *and April* 18. 1791.]

IN ſome other diſſertations, I have endeavoured to inveſtigate the original country of the *Iones*, *Dores*, *Æoles* and *Achæi* or *Achivi;* and have, I hope, ſhewed, that none of theſe tribes were *aborigines* of Greece. In this paper, I ſhall trace the origin of the *Hellenes*, a people who, in proceſs of time, became ſo conſiderable, that all the other ſepts and petty clanſhips of that nation were proud of being called by that venerable name. It was the diſtinction which they deemed the moſt honourable; and Ἑλληνες and Βαρϐαροι, at one time, comprehended the whole human race.

THE more ancient Greeks, however, as well as the people of the eaſt, knew nothing of this appellation. The Italians were equally ſtrangers to it. The ancient name by which the Greeks diſtinguiſhed themſelves, and by which they were known to the weſtern nations, was that of *Graii* or *Græci*, which, it is pretended, they derived from Γραιος, GRAIUS, a very ancient King of Theſſaly. This very ancient perſonage was probably an imaginary chief, who owed his creation to the fertile fancy of the Grecian genealogiſts. The Greeks themſelves muſt have abandoned this denomination at an early period, ſince it never

occurs in HOMER, and indeed very ra rely in other Greeku-thors. ARISTOTLE, ſpeaking of the inundation of Theſſaly in the reign of DEUCALION, is, I believe, the moſt ancient writer who mentions that name *.

PLINY, in the beginning of his deſcription of Greece, informs us, that *Græcia* was the name given by the Romans to that region. "*Ab Iſthmi anguſtiis Hellas incipit, noſtris Græcia* "*appellata* †." The word *Græcia* was peculiar to the Romans; for we never meet with the word Γραικια in any Greek author. As HOMER never uſes the word Γραικοι, we may juſtly conclude, that it was become obſolete in his days. Whence then did the Romans borrow this Gentile appellation? According to DIONYSIUS of Halicarnaſſus ‡, a conſiderable body of the Pelaſgi, expelled from Theſſaly by DEUCALION, after hovering ſome time about Dodona, croſſed over into Italy, and poſſeſſed themſelves of a conſiderable part of that country. Theſe Pelaſgi carried over the name Γραικοι and Γραικια into Italy at that early period, and the Romans, a people by no means fond of innovations, retained it to the laſt.

HESYCHIUS informs us, that Γραια ſignifies the *earth*, and likewiſe CERES. Every body knows, that the ancient Heathens looked upon the *earth* as the moſt ancient of beings. By conſequence,

* Ωικουν γαρ οἱ Σελλοι ενταυθα, και οἱ καλουμενοι τοτε μεν Γραικοι, νυν δε Ἑλληνες. Meteor. Lib. i. cap. 14. LYCOPHRON, an author who affects the antique ſtyle, calls PROTESILAUS Γραικων αριστος, Alex. 532. and in another place he ſays,—Γραικοισιν, αμναμοις τε τοις Ερεχθεως. Ib. 138. Upon this place TZETZES has the following obſervation,—Γραικοι γαρ προτερον οἱ της Ἑλλαδος εκαλουντο. GEORGIUS SYNCELLUS to the ſame purpoſe,—Ἑλλην ὑιος Δευκαλιωνος εγνωριζετο αφ' ȣ Ἑλληνες οἱ Γραικοι μετεκληθησαν. Edit. Par. p. 153. Edit. Ven. p. 122. HESYCHIUS is of opinion, that the word was changed by the Romans. Ραικος, Ἑλλην. Ρωμαιοι δε το γ προσθεντες Γραικον φασι. In voce Ραικος. But this conjecture is evidently falſe. See ALBERTI's Edit. of HESYCHIUS, Vol. ii. p. 1098.

† Lib. iv. cap. 7.

‡ Lib. i. p. 13. Edit. STEPH.

ſequence, the Greeks employed a word derived from the oriental name of that element, to ſignify the *beginning*, and CERES was the ſame deity with TELLUS, or the earth. In Greek, the word Γραυς, nearly the ſame with *grai* or *grau*, ſignifies *an old woman*. Indeed, *grai* and *grau* are actually the ſame; for the ancient Greek alphabet had no *upſilon*. The words Γραιοι and Γραικοι, according to this deduction, imported the original inhabitants of Greece, and was applied to them by the Pelaſgi, in order to exhibit this very character. Every body knows, that the mythologiſts of Greece made no ſcruple to forge imaginary perſonages, upon every occaſion, when they found themſelves embarraſſed in tracing out the progenitors of a nation. Thus, according to them, MEDEUS was the father of the Medes, PERSEUS of the Perſians, PHOENIX of the Phœnicians, SYRUS of the Syrians, &c. According to the ſame arrangement, GRAIUS, if he was not the father of the Greeks, was at leaſt the father of their Gentile name. HELLEN, ION, DORUS, ÆOLUS, ACHÆUS, were beings of the like equivocal generation.

HOWEVER far and wide the term *Hellas* came to be diffuſed afterwards, it was at firſt confined to one ſmall city of Theſſaly. It lay in Phthiotis, a ſmall diſtrict of that country, toward the ſouth. According to STRABO, ſome were of opinion, that Phthia, Hellas, and Achaia, were the ſame. Φθιαν τε, οἱ μεν, την αυτην ειναι τῃ Ἑλλαδι και Αχαιᾳ *. And a little after, he adds:—"Now thoſe who ſay ſo, ſhew you, about ſixty ſtadia "from their city, the ruins of a city which they believe to "have been *Hellas*, and near it two fountains, the one called "Meſſeis and the other Hyperiea." He goes on to inform us, "that the people of Melitæa alleged, that Hellas being ſituated "on a low ground beyond the Enipeus, the inhabitants, pro"bably on account of the unhealthineſs of the ſituation, de"ſerted it, and went over to their city †. The author of the *Brevia Scholia* on the Iliad is of the ſame opinion. "Not in-

"deed

* STRABO, p. 431.

† P. 431.

" deed all the Theſſalians, but only thoſe who dwelt in the " city of Hellas *." Thus it appears, that the Theſſalian Hellas was a very ancient city of the ſmall diſtrict of Theſſaly called Phthiotis, and that lay in the neighbourhood of the river Enipeus.

But the Hellas juſt now deſcribed was by no means the original one called by that name. We learn from Aristotle the following circumſtances †: " For this deluge, ſays he, happened " chiefly about the diſtrict of the ancient Hellenes, and that " near the city Hellas. Now, that city lay near Dodona, on " the Achelous; for this river hath often changed its name. " The Selli inhabited that canton. Theſe were at that time " called *Græci*, and now are denominated *Hellenes*." Here then we have diſcovered the original *Hellas*, the reſidence of the *Selli* or *Helli*, who were firſt called *Helladians*, then Γραικοι, and laſt of all *Hellenes*. Theſe Helli or Selli were the original Hellenes. From them the Gentile name, that afterwards became ſo famous over a great part of the world, was derived, and not from Hellen, the fictitious ſon of Deucalion.

Let us now ſee who theſe Helli or Selli were who dwelt about the Theſſalian *Hellas*, and from whom, we hope to make it appear, that the later *Hellenes* were denominated. Strabo, in his deſcription of Epire, gives the following account of that remarkable people ‡. " Now, concerning Dodona, that the " people who dwelt about the temple were Barbarians, even " Homer himſelf has inferred from the peculiar auſterities of " their manner of living §: *They ſleep*, ſays he, *on the bare* " *ground*

* Ad Iliad. ix. 437.

† Και γαρ ἐτος περι τον Ἑλληνικον εγενετο μαλιστα κ. τ. λ. Meteor. lib. i. cap. ult.

‡ Περι δε Δωδωνης κ. τ. λ. Lib. vii. p. 328.

§ Iliad. xvi. 233. Soph. Trach. 1180.

"*ground with their feet unwaſhed.* But whether we ought to "call them *Helli*, as PINDARUS does, or *Selli*, as they imagine "the name ſtands in HOMER, the ambiguity of the orthogra-"phy does not ſuffer us to determine. PHILOCHORUS tells us, "that the diſtrict about Dodona, as well as that of Eubæa, was "called *Hellopia:* For HESIOD ſpeaks thus: *There is a certain* "*place called Hellopia, diverſified with dales and meads. Here, in* "*the utmoſt corner, is built the city of far-famed Dodona.*" From the concluding part of this quotation, it appears, that the country about Dodona was called *Hellopia*, as well as *Hellas*, which are indeed names nearly of the ſame import, as we hope to make appear in the ſequel. With reſpect to the difference of the terms *Helli* and *Selli*, we may obſerve, that the conſonants *h* and *s* being both aſpirates, are often uſed promiſcuouſly in different dialects, and that of conſequence the *Helli* of PINDAR and the *Selli* of HOMER were one and the ſame people.

From the above quotation it plainly appears, that the original Hellas was a city in the neighbourhood of Dodona; that the diſtrict where it ſtood was called Hellopia; that the inhabitants were called Helli and Selli; and that theſe were the miniſters of the temple there eſtabliſhed. The Theſſalian Hellenes were a colony of the Dodoneans, who emigrated from that canton at a very early period. The Pelaſgi were at that time maſters both of Theſſaly and Epire. Under their protection the Helli erected the oracle of Dodona *. With them a numerous body of thoſe people found a ſanctuary when expelled from Theſſaly by DEUCALION and the Curetes †. It was then natural enough for the ſuperfluous numbers of the Epirotic Helli or Hellenes to emigrate to Phthiotis in Theſſaly, and to colonize a part of that country, eſpecially as it was ſituated at no great diſtance from their native ſeat, and was then in the poſſeſſion of theſe

very

* HEROD. Lib. ii. cap. 52.

† DION. Halic. Antiq. Rom. Lib. i. p. 13. Edit. STEPH.

very people under whoſe protection, and by whoſe permiſſion, they had formed their original eſtabliſhment at Dodona. This detail acquires farther confirmation, when it is conſidered, that the city which they built in Phthiotis was called Hellas, after the name of their metropolis, in the neighbourhood of Dodona. Indeed, it is highly probable, that there was a Dodona in Theſſaly as well as in Epire. This was the opinion of PHILOXENUS, a very ancient writer, quoted by STEPHANUS Byzantinus *, though the author laſt quoted condemns that opinion. As PHILOXENUS was much more ancient than the Byzantine, the probability is, that truth lies on his ſide. We therefore conclude, that the Theſſalian Hellas was built by a colony of emigrants from the city of that name near Dodona in Theſprotia, a diſtrict of Epire.

THE inhabitants of Hellas and its neighbourhood were called *Hellenes*. Accordingly, STRABO actually ſo denominates the inhabitants of that city. *Εκ δε της Ἑλλαδος εν ταπεινῳ χωριῳ κειμενης, εις την ἑαυτων μετοικησαι τȣς Ἑλληνας* †. I know that the Greeks aſcribe the building of this city to HELLEN, the ſon of DEUCALION; but had this been the caſe, the city, according to the idiom of the Greek language, muſt have been denominated Hellenia, and not Hellas.

THESE Hellenes, in proceſs of time, extended themſelves over all the ſouth part of Theſſaly. HERODOTUS is clearly of opinion, that the Hellenes were a Pelaſgic tribe. Speaking of the Pelaſgi and theſe people, he expreſſes himſelf in the following manner:—*Το δε Ἑλληνικον [εθνος] γλωσσῃ μεν, επει τε εγενετο, αεικοτε τῃ αυτῃ διαχρεαται, ὡς εμοι καταφαινεται ειναι, αποσχισθεν μεντοι απο τȣ Πελασγικȣ, εον ασθενες, απο σμικρȣ τεο την αρχην ὁρμωμενον, αυξηται ες πληθος, των εθνεων πολλῳν μαλιϛα προσκεχωρηκοτων αυτῳ και αλλων εθνεων, βαρβαρων συχνων ὡς δη, ὡς εμοι τε δοκει* ‡. As this paſſage is of more than ordinary importance, I ſhall ſubjoin a li-

I teral

* In voc. Dodona. † P. 432. ‡ Lib. i. cap. 58.

teral tranflation of it. " But the nation of the Hellenes, fince " ever it exifted, continues, as far as to me appears, to ufe the " fame language; being a branch cut off from the Pelafgic " ftock, and weak and inconfiderable at the firft, in a fhort " time it increafed into a multitude of people; vaft numbers of " the neighbouring nations in particular, and multitudes of other " barbarians in general, having joined it, as I imagine to have " been the cafe." According to this detail, the Hellenes were fprung from the Pelafgic ftock, and were not fo called from the fabulous HELLEN. Nor is it furprifing that HERODOTUS fhould imagine, that thefe Hellenes were of Pelafgic extraction, when it is confidered, that they lived among thofe people from the time of their firft arrival in thofe parts, and were conftantly under their patronage and protection.

HAVING thus endeavoured to prove, that the Hellenes of Theffaly were a colony of emigrants from the Helli or Selli of Epire, in the neighbourhood of Dodona, let us try if we cannot difcover who thefe people were, and from what country they emigrated, when they came to fettle in thofe parts. We have already feen, that they were the minifters of the temple of JUPITER Dodoneus, and that they were an auftere, afcetic, felf-denied race of men. The origin of the temple of JUPITER at Dodona is accurately defcribed by HERODOTUS *. Its vocal oaks, prophetic doves, and tinkling kettles, have been minutely explained by a great variety of writers, both ancient and modern. It was fituated in Chaonia †, a fmall territory of Epirus, which formerly belonged to Thefprotia, but afterwards to the Moloffi. The temple itfelf lay at the foot of a mountain called *Tomarus* or *Tmarus*. As that mountain rofe from the plain, fomewhat refembling a palm-tree, I imagine the name is derived from the oriental word *Tamar*, which actually fignifies

* Lib. ii. cap. 54. et feq.

† STRABO, p. 328, 329.

a *palm-tree.* HERODOTUS tells us, that this was the moſt ancient oracle of all Greece. The ſame hiſtorian gives us an exact account of the tradition of the Egyptian eſtabliſhment of that oracle *; a tradition "which," ſays he, "was authenticated "by the prieſts of Dodona in my days."

IT appears plainly from HERODOTUS, that this oracle was inſtituted by a prieſteſs from Egypt †, and that it was copied from that of JUPITER at Thebes, or DIOSPOLIS of Egypt. Both were originally conſecrated to the ſun, who was undoubtedly the primary JUPITER of the Pagan world. STRABO infers ‡, I believe not juſtly, from HOMER's account of the Selli who miniſtered in the temple of Dodona, that the original retainers of that eſtabliſhment were men, and not women. HERODOTUS, who had a much fairer opportunity of diſcovering the genuine tradition, plainly intimates, that the perſon who firſt inſtituted the oracle, was one of the prieſteſſes of the Egyptian Thebes. Though the Greek poet mentions only "the "*Selli*, who lay on the ground with feet unwaſhed," it does not follow, that there were not likewiſe *Sellæ* of the like aſcetic character. The ſame geographer informs us, "That in pro-"ceſs of time, when DIONE was admitted to a ſhare of that "temple, three old women were appointed to officiate as her "prieſteſſes §." Theſe female miniſters were called *Peleiades*, which, in the language of Theſſaly, ſignifies *doves* ‖, and hence the origin of the fable concerning the oracular pigeons of Dodona.

HERODOTUS, who had converſed with the Egyptian prieſts upon the ſubject of the eſtabliſhment of the oracle and temple of Dodona, informs us, in the paſſage above quoted, that they homologated the tradition of the Dodoneans with relation to the

* Lib. ii. cap. 55, 56, 57.

† Ibid.

‡ P. 329.

§ P. 329.

‖ HESYCH. in voc. Πελεια.

the certainty of that ancient fact. But it will ſcarce, I imagine, be ſuppoſed, that one ſingle old Egyptian prieſteſs had the addreſs and courage to erect the oracle in queſtion. Whatever the modern Greeks may have dreamed upon that ſubject, ſhe muſt have had men as her co-adjutors in that operation. Theſe co-adjutors were the original Selli. Theſe people were actually emigrants from Egypt and Phœnicia. As the Egyptians, in the earlieſt times, were averſe to navigation, all the Egyptian chiefs who brought colonies into Greece, were obliged to tranſport themſelves on board Phœnician veſſels, and of courſe generally imported a mixture of theſe people. The fact then was,—The original inhabitants of the neighbourhood of Dodona were a colony of Egyptians and Phœnicians *. The Egyptians were, however, the leaders in that emigration. Some part of theſe belonged to the ſacerdotal tribe, and had been originally miniſters of the temple of NO-AMMON, Thebes or Dioſpolis. Theſe probably conſiſted of both ſexes, and theſe actually founded the oracle and built the temple of JUPITER Dodonæus, in imitation of that of the ſame Deity in Egypt. Like the prieſts of Delphi of a later date, they employed a prieſteſs to publiſh the oracles to thoſe who conſulted them. After ſome years, DIONE, or the Moon, was admitted to a participation of the worſhip there eſtabliſhed. Upon this occaſion, three additional prieſteſſes were appointed to miniſter to that divinity.

FROM this deduction, it appears obvious, that the Helli or Selli of Dodona were originally a colony from Egypt and Phœnicia; that the leaders of this colony were Egyptians from Thebais of Egypt; that theſe brought in their train ſome of the prieſts of JUPITER at Thebæ, or were perhaps themſelves a ſwarm diſcharged from that ſeminary; that from them the region about Dodona was called *Hellas*, and the natives *Hellenes*;

ſ 2 that

* I ſay Phœnicians, becauſe moſt of the names of the objects about the temple appear to be Phœnician.

that from them were defcended the Theffalian Hellenes, whofe name was, in procefs of time, adopted by all the nations of Greece.—Let us now try if we cannot produce fomething ftill more plaufible in confirmation of this hypothefis.

THE original term *Hel* fignifies *light*, *brightnefs*, *fplendour*. Perhaps it is the fame with the word *El*, without the afpiration, which is one of the epithets of the true GOD among the Hebrews; for " GOD is light, and in him is no darknefs at all." When the luminaries of heaven became the objects of religious worfhip among the ancient Pagans, moft of the names, titles and epithets which had originally belonged to the true GOD, were transferred to the folar light; confequently *El* or *Hel* became a title of the fun. Among the heathens, it was a prevailing practice to denominate the feveral claffes of priefts from the title of that deity to whom they refpectively miniftered. This point needs no confirmation. If then the Helli in queftion were originally priefts of JUPITER, that is, the Sun, they were of courfe denominated from that deity. Another oriental word now prefents itfelf, which, if admitted into the compofition, will naturally produce the word we are endeavouring to inveftigate. In Hebrew, *En*, or perhaps *Ein*, fignifies both an *eye* and a *fountain*. From a combination of the words *Hel* and *En*, (doubling the *l* in order to ftrengthen the found), we have *Hellen*, which may fignify, either the *fountain* of light, or the *eye* of light, both terms naturally applicable to the fun. The original import of the word *Hellen* was then, according to this etymology, *a worfhipper* or *votary of the fountain of light*, *i. e.* the Sun. As a collateral proof of the juftnefs of this etymology, it may be obferved, that among the ancient Greeks, the word *Helena* was actually a name of the *moon* *, and, by a parity

* The Greek word Σελήνη feems to be the very fame with Ἑλένη, only changing the fpiritus afper into Σ, according to the Æolic dialect. Σιλενος was alfo a name of the fun.

parity of reaſon, *Helenus* muſt have denoted the *ſun*. The difference between *Helenus*, if you cut off the affix *us*, is next to nothing. But that the original word *Hellenes* actually imported *worſhippers of the ſun*, or at leaſt of the *hoſt of heaven*, will, it is hoped, appear obvious from the following obſervations.

IT is a well known fact, that the fathers of the Chriſtian church have divided the early ages of the world into three epochs, which they have diſtinguiſhed by the names of Βαρβαρισμος, Σκυθισμος and Ἑλληνισμος, *Barbariſm*, *Scythiſm* and *Helleniſm*. The two firſt we omit as foreign to our purpoſe; the laſt is a point of great importance towards eſtabliſhing our poſition, and therefore its purport muſt be fully elucidated. It muſt indeed appear ſomewhat extraordinary, to find people talk of a Hellenic period as exiſting many centuries before the Hellenes of Greece had riſen into exiſtence. But theſe holy men were ignorant of the import of the name. They did not know, that the term *Hellen* imported a *votary of the ſun*, the *Hel-En* or *fountain of light*, and intimated the very ſame thing with *Zabians*, or *worſhippers of the hoſt of heaven*. EPIPHANIUS fixes the riſe of Helleniſm to the age of SERUCH. "RAGAM "begat SERUCH, and then idolatry and Helleniſm began "among men *." Helleniſm was then coeval with SERUCH, many ages before the Hellenes of Greece. Indeed, EUSEBIUS and SYNCELLUS make SERUCH the author of the firſt apoſtacy from the true religion †. CEDRENUS makes Helleniſm only as ancient as THARRA. "And NACHOR begat THARRA; then "was introduced the fabrication of images by the ſkill of "THARRA ‡." Here then we have the origin of Helleniſm fixed to a very early period. This apoſtacy conſiſted in worſhipping the hoſt of heaven, the Hel En, the fountain of light.

I Thoſe

* Vol. i Her. i. cap. 6. p. 7.

† Chron. p. 15. SYNCEL. p. 34.

‡ Vol. i. p. 15.

Thoſe who were addicted to that ſpecies of idolatry were called *Hellenim*, or *ſun-worſhippers*, and the appellation was probably fixed on them by thoſe who perſevered in the worſhip of the true GOD.

THE Babylonians, according to the moſt authentic accounts, were the firſt people who worſhipped the hoſt of heaven, and of conſequence were the firſt Hellenes. This name they retained much longer I believe than is generally imagined. The prophet JEREMIAH, foretelling the overthrow of the Egyptians at Carchemiſh on the river Euphrates, introduces the auxiliaries of that army as exhorting one another in a ſpeech to the following purpoſe: "Ariſe, and let us go again to our own "people, and to the land of our nativity, from the face (edge) "of the ſword of the *Jonim* *." The Seventy tranſlate the laſt clauſe, *Απο προσωπȣ μαχαιρας Ἑλληνικης*. Again, in another place †, we have the very ſame words tranſlated in the ſame manner. It would be abſurd to imagine, that the tranſlators were ſo ignorant as to ſuppoſe that the Greeks were really intended in theſe paſſages. They could not but know, that the inſpired writer alluded to the Babylonians; and that the Græcian Hellenes at that period, could have no manner of connection with the Babylonians. The fact is, they knew that theſe people had been often ſtyled *Hellenes*, i. e. *worſhippers of the ſun*. They knew that this was a general appellation by which theſe people were known over all the neighbouring countries, and conſequently applied it to them without the leaſt heſitation. This account, in my opinion, furniſhes a very ſtrong preſumption, that the Babylonians were the original Hellenes, and that this name was applied to them in conſequence of their attachment to the worſhip of the ſun.

JOHANNES Antiochenus ſtyles the Midianites Hellenes. He calls JETHRO, the father-in-law of MOSES, *Αρχιερευς των Ἑλλη-*

νων,

* Chap. xlvi. ver. 16. † Chap. l. ver. 16.

νων *, *high prieſt of the Hellenes.* Of what Hellenes? Surely not of the Græcian Hellenes, but of the Midianitiſh, that is, of the Midianites who were worſhippers of the ſun, moon and ſtars.

On the upper receſs of the Arabian gulf, there was a city called *Elana*, and ſometimes *Ailane*. On the oppoſite ſide are fountains, called by the Arabians *El-Ain* to this day. El-Ain, the very peaſants of the neighbourhood know to import *fontes ſolis*, "the fountains of the ſun." This fact again furniſhes a very plauſible argument in favour of the etymology propounded above.

The invaſion and conqueſt of Egypt by the Paſtor Kings, is an event generally known, and as generally admitted. Africanus † calls theſe people, Ποιμενες Ἑλληνες and Βασιλεις Ἑλληνες, "Hellenic ſhepherds and Hellenic Princes." It cannot be pretended, that thoſe foreigners had the moſt diſtant relation to the Hellenes of Greece, except from the identity of name. No; they were only worſhippers of Hel-an, "the fountain of "light." For the ſame people are called *Auritæ* and *Oritæ*, from *Aur* and *Or*, originally *light*, *heat*, and, by a very common metonomy, *the ſun*. Thoſe intruders were probably addicted to the worſhip of the ſolar Deity, and were conſequently ſtyled Hellenes, Auritæ and Oritæ, that is, *Sunites*, or votaries of the ſun. It then appears, that there were Hellenes in Chaldæa and Arabia at a very early period, (for I take it for granted, that the Paſtors who invaded Egypt were Arabians), and in Midian; and that, from the import of the term, theſe Hellenes were ſo denominated from their being addicted to the worſhip of the heavenly bodies.

As there were Hellenes in the countries above mentioned in the very firſt ages after the flood, ſo it will appear by the following quotations, that there were Hellenes likewiſe in Egypt much about the ſame period of time. Philo Judæus, in his life

* P. 76, 77.

† Apud Syncellum, p. 61.

life of MOSES, after informing his readers, that this legiſlator had been inſtructed, during his youth, in arithmetic, in geography, in hieroglyphics, adds, τηνδε αλλην εγκυκλιαν παιδειας, κ. τ. λ. *, "the remainder of the circle of ſciences he learned from "the Hellenes;" not I ſuppoſe from the Hellenes of Greece, who, if they did exiſt at that early period, were ſtill a race of barbarians, if not abſolute ſavages; but from the Egyptian prieſts of that denomination, who had actually by that time eſtabliſhed ſeminaries or colleges in ſeveral parts of Egypt, as early as the age of MOSES. The learned Jew was acquainted with the term Hellenes, but was ignorant of its import and ſignification. He is indeed groſsly miſtaken in his application of it; as is likewiſe CLEMENS Alexandrinus, who borrows it from him, and applies it to the ſame purpoſe †.

DIODORUS Siculus informs us, that the great OSIRIS, returning from his travels over moſt parts of the then known world, "inſtituted religious ceremonies, and founded ſchools of eloquence in Egypt. Of theſe he appointed HERMES the Prefect, who taught the Hellenes the rites relating to augury and "divination ‡." Theſe Hellenes could be none other than the prieſts of Hel En, that is, the Sun. The ſcholiaſt on APOLLONIUS's Argonautics informs us from DICEARCHUS, that "SESONCHOSIS, *i. e.* SESOSTRIS, was a zealous imitator of the Hellenic way of life §. The author's meaning is no doubt, that he was an admirer of the auſtere manner of life practiſed by the Hellenes, or prieſts of the ſun.

FROM the foregoing detail, we hope it will appear, that there were in the eaſtern parts of the world people called Hellenes, many ages before the Hellenes of Greece were known or exiſted; that this was originally not a Gentile, but a ſacred or religious name; that it meant worſhippers of the ſun, and imported

* Vol. ii. p. 84.

† Vol. i. p. 413.

‡ Lib. i. p. 16. Edit. STEPH.

§ Lib. v. ver. 273.

imported much the ſame idea with the term *Zabian*; that in Egypt in particular there was a race of prieſts denominated Hellenes.—Let us now ſee to what purpoſe we mean to apply the foregoing obſervations.

We have already ſhewn from Herodotus, that the oracle of Dodona was an Egyptian erection; that the Helli or Selli were the miniſters of the Deity; that theſe Helli, afterwards Hellenes, were originally worſhippers of the Sun, this planet being the primary Jupiter of the Greeks and Romans; that there was in the neighbourhood of that temple, a city called Hellas, the capital of a diſtrict called Hellopia; that the inhabitants of this canton were the original Hellenes of Greece; and, laſtly, that the Theſſalian Hellenes were a colony of emigrants from the laſt mentioned people. I ſhould now proceed to inveſtigate by what means the Hellenes of Theſſaly grew ſo conſiderable, as to communicate their name to all the other communities of Greece. But before I enter upon this part of the ſubject, I ſhall take the liberty to hazard a few etymological conjectures, which, if admitted, will operate as collateral proofs of the hypotheſis.

I observed in that part of this diſquiſition where I treated of the emigration of the Dodonean Helli, that, though the leaders of the colony were undoubtedly Egyptians, yet a number of Phœnicians were probably mingled with theſe emigrants. I ſhall now ſhow, that moſt of the names connected with the temple and oracle, were actually Phœnician. Hellopia, the name of the canton around the temple, ſignifies a territory ſacred to the ſun and the moon. I have ſhewn above, that *El* or *Hel* was a name of the ſun. *Ops*, *Opis*, *Upis*, was a Pelaſgic name of the moon. In the Egyptian language, *Ob* was a name of the ſun, and of courſe *Oba* became a title of his ſiſter divinity. The conſonants *b* and *p* being both labials, naturally paſs into each other. Hence *Oba* or *Uba* became *Opa* and *Upa*. From *Hel* and *Opa* combined originates *Hellopa*;

whence the adjective Ἑλλωπια, with the word χωρα underſtood, intimating the Hellopian diſtrict. Again, *Hellas*, originally *Hellad*, as is obvious from the genitive *Hellados*, is compounded of *Hel*, *light*, *ſplendour*, &c. and *Ad*, an original name of the ſun *. Hellas is then much the ſame with Heliopolis, the city of the ſun. I have obſerved above, that *Tmarus* or *Tomarus*, *the mountain overhanging the temple*, might ſignify a *palm-tree*; but it may, with more probability, be compounded of the words *Tam*, *integer*, *perfectus*, and *Or* or *Ur*, *heat* or *light*. As it was an univerſal practice among the heathens to conſecrate particular mountains to particular deities, and as the one in queſtion lay contiguous to the temple of the ſun, there can be no doubt of its being conſecrated to that deity. The name Dodona itſelf I take to be a *vox hybrida*, compounded of the Greek word Δω, *domus*, and the Phœnician *Adon*, *dominus;* ſo that *Dodona* is the ſame with *Do-Adon*, *the houſe of the* LORD. The prieſteſſes of the temple were called πελειαι †. The Chaldean word *Peleh* ſignifies *ſervivit*, *coluit*, and is upon ſome occaſions actually employed to intimate the miniſters of the houſe of GOD ‡. HESYCHIUS informs us, that the word πελεια in the Theſſalian tongue ſignified *a dove*. This bird every body knows was ſacred to VENUS among the Greeks and Romans, and to the Moon among the Syrians. Hence the prieſteſſes were called πελειαι, becauſe they miniſtered to DIONE in the temple of Dodona; and the pigeon had the ſame denomination, becauſe it was ſacred to the ſame deity. The Lacedæmonians called the temple of JUPITER in Dodona Ἑλλα §, a term evidently derived from *Hel;* and this was perhaps its original denomination. All theſe names are clearly of Phœnician extraction, nor are the etymologies obſcure and equivocal. Every

* Macrob. Sat. lib. i. cap 23.

† HESYCH. in voce.

‡ See Ezra vii. 24. *et alibi.*

§ HESYCH. *in voce* Ἑλλα, καθεδρα, και Διος Ιερον εν Δοδωνῃ. Λακωνες.

ry one verſed in etymological enquiries will, I am perſuaded, admit them as probable, if not abſolutely certain. Perhaps the Phœnicians conſtituted the more numerous part of the colony, and of courſe, though the leaders were Egyptians, the language of the majority, as is uſual in ſuch caſes, might become the prevailing dialect. This too muſt have been mingled with the Pelaſgic, which was probably a branch of the old Phœnician, or, at the moſt, very little different from that language. At the ſame time, it is generally allowed, that the Egyptian and Phœnician were no more than different modifications of the ſame tongue. Thus, it appears, that moſt of the names of places and perſons connected with the temple of Dodona, as well as that of the temple itſelf, were of a Phœnician or Egyptian original; a circumſtance which, in my opinion, ought to give additional weight to the arguments above adduced in confirmation of my poſition.—I ſhall now endeavour to point out the means by which the Hellenes of Theſſaly grew ſo conſiderable as to communicate their name to all the other tribes of Greece.

The Hellenes, when they arrived in Greece, brought along with them a large ſhare of the culture and civilization both of Egypt and Phœnicia, at that time the two moſt poliſhed countries upon earth. The emigrants from Dodona to Phthiotis no doubt carried along with them all the improvements of the parent colony. The inhabitants of Theſſaly were at that time a race of barbarians. This aſſertion ſtands in no need of being authenticated by quotations. It is confirmed by the unanimous conſent of antiquity. It is no hard matter to conceive how quickly a race of people, prodigiouſly ſuperior both in arts and arms, muſt gain the aſcendant among a rout of uncultivated, vagabond ſavages. Their manners, their dexterity, their ſkill in the mechanical arts, their policy, perhaps their ſuperior courage and diſcipline, would naturally enough excite the admiration, and conciliate the affections, of all the tribes of

barbarians around them. The religious ceremonies which they introduced would render them venerable, and gain them multitudes of profelytes. The arts of augury, vaticination, and magic, would all co operate to enhance their reputation. Agriculture, in that age little known, and ftill lefs practifed in Greece, would be embraced with grateful hearts by the half-famifhed favages. They would look up to the authors of that bleffing with the fame fentiments which prompted the Roman poet to invoke BACCHUS and CERES benign:

> LIBER *et alma* CERES, *veftro fi munere tellus*
> *Chaoniam pingui glandem mutavit arifta.*

THE alliance of fuch a fuperior people would be eagerly courted, their manners would be imitated; to incorporate with them by blood and affinities would be deemed honourable, and would, at the fame time, be found fafe, improving, and advantageous. Their neareft neighbours would be firft drawn into the vortex; the infection would gradually diffufe itfelf far and wide, till, in procefs of time, it extended its influence to all the oriental colonies at that æra newly eftablifhed in Greece. Indeed, all thefe colonies looked upon themfelves as brethren, as appears from the relation they all claimed to the family of their imaginary HELLEN. All thofe tribes might, in reality, look upon themfelves as brethren, as they had emigrated from the fame quarters, and were defcended of patriarchs who actually ftood in that relation to each other. Thus, the colony of the Hellenes, which, according to HERODOTUS, quoted above, was at the firft weak and inconfiderable, by the acceffion of its neighbours and numbers of the barbarous nations around, became ftrong, populous, and confiderable. The original name of *Graii* was forgot; and firft the cantons in the neighbourhood of Phthiotis, and afterwards, in a fhort time, almoft all the fepts of Greece, became *Hellenes*. Nothing lefs than the moft exalt-

ed idea of the ſuperior dignity and accompliſhments of the Hellenes could, I think, have induced the circumjacent nations to abandon their reſpective Gentile denominations, and adopt that of an inconſiderable tribe of foreigners, but lately eſtabliſhed among them. This opinion they muſt have excited by the means enumerated in the preceding pages.

THE ancient Egyptians, like the modern Chineſe, were the moſt vain-glorious nation upon earth. Accordingly, HERODOTUS aſſures us, that they ſtigmatiſed all nations with the title of barbarians. *Βαρβαρους δε παντας οἱ Αιγυπτιοι καλεουσι τους μη σφισι ὁμογλωσσους* *. The Helladians or Hellenes brought this epithet with them into Greece, and, we believe, applied it literally to all thoſe clanſhips around them which had not entered into alliance with them, or had not aſſumed their name. This epithet was at firſt confined to ſuch of the nations of Greece as were not connected with the body of the Hellenes. In proceſs of time, however, it became ſo widely extended as to produce the general diviſion of mankind into *Ἑλληνες και Βαρβαροι*, "Greeks and Barbarians." The influence of this diſtinction ſoon became irreſiſtible among a conceited, vain glorious people. We learn from HERODOTUS, that the Athenians, who, according to him, were a Pelaſgic tribe, changed both their name and language in order to become Hellenes. *Το Αττικον εθνος εον Πελασγικον, ἁμα τῃ μετηβολῃ τῃ ες Ἑλληνας, και την γλωσσαν μετεμαθε* †.

BUT nothing contributed ſo much to extend the name and influence of the Hellenes, as the inſtitution of the council of the Amphictyones. The inſtitution of this patriotic and truly beneficial diet is generally aſcribed to the wiſdom and policy of one AMPHICTYON, a deſcendent of HELLEN, and a King of the Athenians ‡. That AMPHICTYON, if any ſuch perſon ever exiſted,

* Lib. ii. cap. 158. in fine. † Lib. i. 57.

‡ M. GEBELIN, in his *Diſc. Prelim. ſur les Orig. Grecs*, has given a very exact account of the inſtitution of this council. According to him, AMPHICTYON is an

iſted, was of the Hellenic race, cannot be doubted. The deſign, the uſefulneſs, the arrangement of the inſtitution, evidently breathe an Hellenic original. It is not my intention at preſent to enter upon a detail of the functions or regulations of that celebrated court. I ſhall only obſerve, that the confederated ſtates being twelve in number *, lodged their reſpective intereſts in the hands of that council or diet; that this council was formed of a certain number of deputies from each of the allied cantons; and that theſe cantons were at firſt ſituated around the city of Delphi in Phocis, where the Amphictyones held their aſſembly.

THE arrival of new colonies, time after time, from the coaſt of Phœnicia, which generally conquered, expelled, ſubjected, or extirpated the indigenous inhabitants of theſe countries, when they reſpectively made their deſcents, ſuggeſted the idea of the confederacy juſt mentioned. The Hellenes, in all probability, projected the alliance. It was a ſcheme ſuitable to the refined ſagacity of a political and enlightened people. This ſuppoſition becomes the more plauſible, when we reflect, that the arrangement is aſcribed to a branch of the Hellenic family †. The Attics, ever prone to engroſs every thing great or meritorious to themſelves, have, of courſe, dignified this ideal perſonage with the Royal title. He always appears in the liſt of their Kings. Self-preſervation, the moſt powerful of all motives,

an imaginary perſon, which I think is highly probable. His etymology of the name is altogether fanciful; αμφι ſignifies *round, around, about;* and he imagines there might be an obſolete Greek verb κτυω, *defendo*, whence the Latin *tueo*, now *tueor*. After the ſame manner, we have κταω, *poſſideo*, now κταομαι, κτεινω, *occido*, &c. The κ is a mere adventitious prefix, calculated to invigorate the pronunciation. According to this etymology, the word *Amphictyones* will import perſons whoſe office it was to protect all the circumjacent people.

* Authors only enumerate eleven. See more on this ſubject in the Appendix, p. 153.

† Some make him the ſon of DEUCALION, others that of HELLEN.

tives, would readily determine the petty ftates lying between the modern Theffaly and Peloponnefus to prefs into the alliance. At the fame time, gratitude for this benefit, as well as for thofe enumerated in the preceding pages, might naturally enough engage them to adopt the Gentile denomination of their gracious benefactors.

At firft the Gentile name Hellenes was confined to the cantons connected by the Amphictyonic confederacy; and thefe, as was juft now obferved, were all fituated between the confines of modern Theffaly and the Ifthmus of Corinth. When the Dores, who were members of that confederacy, invaded and conquered Peloponnefus, they communicated that name, which themfelves had adopted before they left their original feats, to the inhabitants of their new conquefts; and now all the Grecian tribes without diftinction became Hellenes. At length the epithet of Barbarians, which at firft comprehended only the tribes in the neighbourhood of the Hellenes who did not accede to the alliance reprefented by the Amphictyones, was extended to all the nations unconnected with the Hellenic tribes.

To conclude; the Hellenes were not a particular race of people, nor were they denominated from HELLEN, the fabulous fon of DEUCALION. They were a fect of idolaters, peculiarly addicted to the worfhip of the fun, who was, in fome of the eaftern dialects, called *Hel-En*, i. e. *the fountain of light*. They were found in Babylon, in Midian, in Arabia on the confines of Egypt, and more particularly in Egypt itfelf, where there were feminaries of learned men called Hellenes. From one of thefe facerdotal feminaries, eftablifhed at Thebes or Diofpolis, emigrated the leaders of the colony of Helladians, which fettled in the neighbourhood of Dodona. Thefe built the city of Hellas, and from them the canton which they poffeffed

2 was

was called Hellopia. They likewiſe built the temple and inſtituted the oracle of Dodona, under the protection of the Pelaſgi, who had emigrated from the ſame quarters, and who at that time were maſters of that region. As theſe Hellenes muſt have tranſported themſelves to their new ſettlements on board Phœnician veſſels, a goodly number of Phœnicians muſt have joined them, and mingled with them in Hellopia and its vicinity. Hence moſt of the names of perſons, offices, places, &c. connected with the temple are evidently of Phœnician original. In proceſs of time, a new colony emigrated from Hellopia into Phthiotis, a ſmall diſtrict toward the ſouth of Theſſaly, where they built the city of Hellas, and where they ſtill retained their original name. Theſe new coloniſts brought along with them all the arts, culture, politeneſs, &c. which their anceſtors had imported from Egypt and Phœnicia, at that period the moſt highly civilized countries upon earth. Theſe new ſettlers, in conſequence of their ſuperiority in arts and arms, and the benefits their more eminent accompliſhments enabled them to confer, eaſily gained the aſcendant among the neighbouring Theſſalians, who were at that time a race of barbarians. The proſpect of ſharing theſe advantages allured the neighbouring tribes either to join or ſubmit to them, and rendered them ambitious of the honour of being called by their name. The original Hellenes had learned from their Egyptian countrymen to brand with the name of barbarians all who did not ſpeak the ſame language with themſelves. This epithet the vain-glorious Hellenes liberally beſtowed upon all the neighbouring nations which were too proud or too obſtinate to court their alliance. It appears from the example of the Athenians, that the dread of being branded with this epithet contributed not a little to draw the adjacent people into a confederacy with the Hellenes. The inſtitution of the Council of the Amphictyones under the auſpices of the Hellenes completed their triumph; and the dread

dread of being ſwallowed up by the oriental colonies which were from time to time arriving in Greece, engaged all the petty dynaſties in the neighbourhood to ſolicit admittance into that confederacy. At firſt this aſſociation conſiſted only of twelve petty ſtates, and reached from the ſouthern confines of modern Theſſaly to the Iſthmus of Corinth. When the Dores, who had been included in the Amphictyonic league, and had conſequently adopted the name of Hellenes, fell into Peloponneſus, and made themſelves maſters of the greateſt part of that country, they communicated their name to their new ſubjects; ſo that, in proceſs of time, the original name *Graii* was abandoned and forgotten, and all the tribes of the Greeks became *Hellenes*; a name which they retained as long as the nation exiſted. Hence, in proceſs of time, all mankind came to be divided into Ἑλληνες και Βαρϐαροι, "Greeks and Barbarians."

END OF THE DISSERTATION.

APPENDIX CONCERNING THE AMPHICTYONES.

THOUGH I have omitted the explication of the council of the Amphictyones in the body of the preceding diſſertation, in order to avoid prolixity, I ſhall here add a few ſtrictures upon that ſubject.

IT was obſerved in the foregoing paper, that the Greeks aſcribed the inſtitution of this council to AMPHICTYON. This Prince, according to them, was the ſon of DEUCALION, and

the brother of the far-famed HELLEN, though ſome pretend that he was his ſon. The Athenians, who arrogate every thing to themſelves, aſſert, that he was one of their Sovereigns. They tell us, that he came to Athens, and married the daughter of CRANAUS, the ſecond King of Athens *. This unnatural Prince dethroned his father-in-law, and uſurped the Crown. He reigned eleven, ſome ſay twelve years †, and was in his turn expelled by ERICHTHONIUS. According to APOLLODORUS, ſome were of opinion, that this ſame AMPHICTYON was not the ſon of DEUCALION, but a native of Attica ‡; and if ever ſuch a perſon did actually exiſt, I ſhould imagine the latter opinion by far the moſt probable. But in either caſe, nothing can be more abſurd than to ſuppoſe, that a petty ſovereign of a territory, ſituated at a conſiderable diſtance from the centre of union, and unconnected with all the other ſtates engaged in the confederacy, ſhould have been poſſeſſed of ſufficient influence and authority to accompliſh an enterpriſe of ſuch magnitude and importance. The very idea carries inconſiſtency in its aſpect. This claim we muſt therefore place to the account of Athenian vanity.

SOME have aſcribed the inſtitution to ACRISIUS, King of Argos §, a poſition ſtill more improbable, if poſſible, than the former. That Prince was too inconſiderable, and lived at too great a diſtance, to have projected ſuch a plan, or, if he had, he could never have carried it into execution. What could have induced a Sovereign of Argos to intereſt himſelf in the concern of a temple ſo remote from his own dominions? What motive can we imagine could have engaged ACRISIUS to project an inſtitution calculated to promote the union and ſecurity of a number of tribes with which he was altogether unconnected?—an inſtitution from which neither himſelf nor his ſubjects

* APOLLOD. Bib. cap. iii. p. 221. PAUSAN. in Att. cap. 2. p. 7. bottom.

† Id. ib. ‡ Id. ib. § STRABO, lib. ix. p. 420.

ſubjects could ever hope to derive the ſmalleſt advantage. The opinion which attributes this eſtabliſhment to the wiſdom and penetration of the Argive Prince, is therefore, in all reſpects, baſeleſs and nugatory.

Androtion, quoted by Pausanias *, appears to me to have given the genuine account of the inſtitution of this celebrated council: Ανδρωτιων δε εν τη Ατθιδι, εφη, συνγραφη, κ. τ. λ. "But Androtion, in his Hiſtory of Attica, tells us, that "from the moſt early period, deputies from the neighbouring "ſtates aſſembled at Delphi, and that theſe deputies were, "*from that circumſtance* called *Amphictyones*, and that conſe-"quently, in proceſs of time, this became the prevailing de-"nomination of that high court." However this author may be miſtaken in his etymology, he is certainly orthodox in his opinion relating to the original of this renowned aſſembly. It was an original inſtitution. It did not derive its primary exiſtence, either from Amphictyon or Acrisius, or indeed from any particular perſon. It was a convention το εξ αρχης. It exiſted from the earlieſt ages of antiquity.—Let us now ſee whether it is not poſſible to give at leaſt ſome probable account of its primary erection.

As the Hellenes had founded the oracle of Dodona, ſo the ſame people, in all probability, eſtabliſhed the oracle of Delphi. They had ſeen the amazing credit and ſucceſs of the former, and expected the like reputation and aggrandizement of the latter. The event proved, that the conjecture was founded in reaſon and ſagacity. The renown of the Delphic erection in a ſhort time eclipſed that of the fane of Dodona. The Greeks, who have ever been diſtinguiſhed by their itch for novelty, quickly reſorted in crowds to this newly erected office. In a few years, the temple became flouriſhing and opulent. The Delphic Pythoneſs, tutored by the Hellenes uttered her myſterious predictions with ſuch ſuperior ſagacity, that the events, in many inſtances, verified their divine original, or at

* Lib. x. cap. 8. p. 815.

leaſt were imagined to do ſo by the deluded votaries. The reſponſes were generally conceived in ſuch equivocal terms as left it in the power of the Hierophant to explain them in ſuch a manner as might ſave the credit of the Pythian god, be the iſſue what it might. Numberleſs fables were circulated among the Greeks, with relation to the portents and prodigies which prompted the people in the neighbourhood of Parnaſſus to erect this ſacred edifice, and which attended the erecting of it. For my own part, I am fully convinced that it was a Hellenic eſtabliſhment, founded by the emigrants of that colony from the neighbourhood of Dodona, and actually copied from that oracle. Such changes were probably made as experience had pointed out for a courſe of ſeveral ages, during which the mother Oracle had been in reputation. I mean not to compile a hiſtory of this oracle; my intention is only to ſhew, that the inſtitution of the council of the Amphictyones is actually connected with this oracular eſtabliſhment.

THE concourſe to the temple of Delphi ſoon became immenſe. Its ſituation was happily choſen for that purpoſe *. It lay nearly in the centre of thoſe petty tribes which afterwards formed the Amphictyonic aſſociation. Theſe ſtates, as was obſerved in the diſſertation, became jealous of the growing power of the oriental colonies. Delphi appeared to them a convenient place for holding their conventions, agreed upon in order to concert meaſures for their mutual ſecurity. Both its ſanctity and centrical poſition pointed it out as a place altogether

* STRABO, *ubi ſupra.* It lay nearly in the centre of Greece, but the Greeks entertained an opinion, that it was ſituated in the centre of the world—*ομφαλος της οικουμενης*, *the navel of the habitable world.* So STRABO, lib. ix. p. 419. SOPHOCL. in OEDIP. Tyr. EURIP. in MEDEA. et alibi. PLUT. de defect. Orac. ſub Init. PAUS. lib. x. p. 835. PIND. Pyth. iv. 6. It was originally called Lycoræa. Two Egyptian words compoſe it. *Λυκ* in many languages ſignifies *light*, and *Ωρ* ſignifies the *Sun*.

ther fitted for that purpofe. The Hellenic Prefects of the temple, fuperior to the Barbarians in political fkill and fagacity, would ftrain every nerve to promote a fcheme calculated to advance both their honour and their intereft.

In all ages, and in all countries, to partake of the fame common facrifices has been deemed an infallible fign of amity and concord, Firft of all, then, the confederates affembled at Delphi, at certain ftated feafons, to offer facrifices, and perform other religious rites in name of all the affociated tribes *. This was the moft indiffoluble bond of their fœderal union. Upon thefe public and folemn occafions, magnificent donations were offered to the Pythian god, and his minifters no doubt fhared largely in thefe munificent effufions of devout liberality. As in confequence of thefe public donations, and the bountiful largeffes of private individuals, who crowded from all quarters to confult the oracle, the treafury of the temple became exceedingly rich, the confederates imagined, that it concerned their honour, and perhaps their intereft, to appoint officers to fuperintend that treafure. Strabo tells us exprefsly, that this was one of the ends of the inftitutions of the Amphictyones †. Και τȣ ἱερȣ, κ. τ. λ. "And they were to have the fuperintendency "of the temple in a more public capacity, which, as there was a "prodigious mafs of treafure and donations depofited in it, "needed to be carefully watched and hallowed with purity." Thus it appears, the the original Amphictyones were a kind of wardens of the temple of Delphi, elected by the fuffrages of the confederated tribes.

In

* See Herod. lib. i. Ephefus, and the temple of Diana there, was the centre of union among the people of Leffer Afia, and we find that Tarquinius Priscus projected a like centre of union among all the petty ftates of Latium. Cæsar informs us, that the Gauls had a like centre of refort in the territory of the Carnutes, where the Druids affembled once a-year to offer facrifices in name of all the communities of Gaul.

† Lib. ix. p. 420.

In proceſs of time, it was imagined, that another claſs of officers ſhould be added to the former, whoſe province it ſhould be to watch over the civil intereſts of the confederacy. Theſe two claſſes of ſuperintendents gradually coaleſced into one, and both united in diſcharging the ſacred and civil functions annexed to their office. Each of the confederated ſtates ſent two deputies, without any regard to its extent or populouſneſs. The one was denominated Ιερουμενον, *Hierumenon*, and the other Πυλαγορας, *Pylagoras*. The former was choſen by lot, and his buſineſs ſeems to have been more immediately to inſpect and ſuperintend matters relating to religion, ſuch as ſacrifices, auguries, rites, ceremonies, &c. Theſe officers I take to have been a part of the original conſtitution. The latter was elected by a plurality of voices, and his province ſeems to have been originally confined to the civil department. Both theſe had an equal right to deliberate upon, and vote in all matters that came before the aſſembly.

These ſtated times of aſſembling were twice in the year, once in ſpring, and once in autumn. Their ſpring meeting was called Εαρινον πυλαιον, their autumnal Μετωπωρινον. The reaſon of this appellation was, according to the writers of Greece, owing to their having been originally inſtituted at *Pylæ*, afterwards called *Thermopylæ*. The duration of their ſitting was not limited, but extended in proportion to the multiplicity, magnitude, or difficulty of the buſineſs which came before them. Before they entered on buſineſs, they jointly ſacrificed an ox, cut into ſmall pieces, which was a ſacramental ſymbol of their amity and concord. Though their ordinary place of meeting was at Delphi, they ſometimes adjourned to Thermopylæ. But this only happened when that city was threatened with a hoſtile invaſion, or when the exigencies of the communities made the latter a more commodious ſtation. When they aſſembled at Thermopylæ, they held their ſeſſions in the temple of Ceres, near the mouth of the river Aſopus. The fifth epo-

cha of the Arundelian marbles, marks the inftitution of this council.

THE Amphictyones, before they began their deliberations, were obliged, as we learn from ÆSCHINES, to take the following moft dreadful oath. "I fwear never to overthrow any of the "cities which enjoy the privilege of fending deputies to this "council; never to divert the courfe of any river, either in "peace or war. If any people fhall come with any fuch de-"fign, I engage to carry war into their country, to raze their "cities, boroughs, and villages, and to treat them, in all re-"fpects, as my moft implacable enemies. If any fhall be "found fo impious as to dare to rob the temple of APOLLO at "Delphi of the rich donations laid up there, or to favour fuch "an attempt, to employ all my efforts, with hands, feet, and "voice, to inflict vengeance on the facrilegious wretch." This oath was accompanied with a moft dreadful imprecation againft thofe who fhould violate or falfify it. The imprecation was conceived in the following terms: "If any man fhall violate this "oath, be he private man, city, or people, may he feel the ven-"geance of APOLLO, of DIANA, of LATONA, of MINERVA the "Provident! May his lands yield no fruit! May their wives, and "even their cattle, bear nothing but monfters! May the facri-"legious wretches lofe their law-fuits! May they be vanquifh-"ed in battle, and finally perifh, themfelves, their houfes, and "all their offspring! Let their facrifices never be accepted by "APOLLO, DIANA, MINERVA the Provident! May thefe dei-"ties abhor their vows and their offerings!" Let us now fee with what powers and privileges this auguft affembly was invefted.

No private caufes were determined by this court. Thefe were deemed too trivial and uninterefting to engage the deliberation of this auguft convention. Their functions were partly of a facred, and partly of a civil complexion. The former have been elucidated in the preceding pages. As civil magiftrates, they

they were employed in maintaining peace and concord among the confederated ſtates, by oppoſing ſuch injuries as they mutually committed againſt each other; by determining ſuch diſputes as might ariſe between neighbouring people, with relation to their boundaries, poſſeſſions, privileges, claims, juriſdictions, &c.; by concerting ſuch meaſures as they deemed neceſſary for maintaining the general confederacy. They endeavoured to protect the weaker ſtates from the oppreſſion of the more powerful; to determine the cauſes and nature of complaints; to redreſs public grievances of every deſcription, and to promote every project that might conduce towards advancing the public weal, tranquillity and proſperity. In ſhort, all public differences among the confederates, whether relating to matters of peace, of war, or of religion, fell under the cognizance of this venerable court. Its deciſions were ſigned by the high-prieſt of Delphi, after which they were received with the deepeſt veneration, and engraved upon pillars of marble, in order to be preſerved as authentic monuments. We meet with frequent inſtances of the power of this court in the Grecian hiſtory. Even the Phœnicians, the very people among whom it was firſt erected, felt, in latter times, the dreadful effects of its power and reſentment.

We are aſſured, that the cantons aſſociated in the Amphictyonic league were twelve in number, and yet no author that I have had an opportunity of conſulting mentions more than eleven. The reaſon, I believe, is this: The name of the Hellenes, who were originally at the head of the aſſociation, was, in proceſs of time, abſorbed by that of the Theſſalians. According to Æschines, the confederacy conſiſted of the Theſſalians, the Bœotians, the Dorians, the Ionians or inhabitants of Attica, the Perrhæbians, the Magnetes, the Locrians, the Oeteans, the Phthiotes, the Maleans, and the Phoceans. Harpocration names likewiſe eleven; the Dorians, the Ionians, the Perrhebians, the Bœotians, the Magnetes, the Acheans, the Maleans,

Maleans, the Dolopes, the Ænianes, the Delphians, and the Phocians. PAUSANIAS enumerates only ten; the Iones, the Dolopes, the Theſſalians, the Ænianes, the Magnetes, the Maleans, the Phthiotes, the Dores, the Phocians, the Locri, who bordered upon Phocis under Mount Cnemis. The reaſon of this diverſity probably ariſes from this circumſtance: Some of the confederated ſtates might aſſume new names, and ſome ſtates might be ſtruck out of the alliance, in conſequence of ſome miſdemeanour, and others ſubſtituted in their room.

SUCH was the far-famed Council of the Amphictyones; a tribunal which reflects immortal honour upon Greece, and demonſtrates the wiſdom, ſagacity and political talents of the Hellenes, who eſtabliſhed ſo noble and ſo uſeful an inſtitution. Happy, had it been inveſted with power ſufficient to check the ambitious enterpriſes of ſome of the confederated ſtates, which formed projects for reducing the reſt to a ſtate of dependence and ſervitude. Had its members been always animated with a ſpirit of peace, of juſtice, and good order, it would have rendered itſelf for ever reſpectable, and the aſſociated ſtates under its direction ſhould never have become a prey to the once deſpiſed Macedonians.

STRABO pretends, that the college of the Amphictyones was aboliſhed with the Achæan league. But PAUSANIAS mentions it as exiſting in his time, and as conſiſting of thirty conſtituent members. Nicopolis, Macedonia, and Theſſaly, ſent two a-piece. The Bæotians, Phoceans, and Delphians, ſent each two members. One was furniſhed by the ancient diſtrict of Doris. The Ætolians, called Ozoli, and the people beyond the ſtrait of Eubœa, ſent one member each. The Eubœans and the Athenians furniſhed each one delegate.

AFTER the conqueſt of Greece by the Macedonians, this tribunal was ſhorn of its primitive luſtre. AUGUSTUS too made ſome new regulations with reſpect to the ſtates which

were inveſted with the privilege of ſending deputies to that Council. Though it ſubſiſted in the days of PAUSANIAS, who flouriſhed under ANTONINUS PIUS, it was probably of ſo little repute, in the age of STRABO, that this geographer looked upon it as in a manner annihilated.

END OF THE THIRD VOLUME.

ERRATA.

PHYSICAL CLASS.

Page 27, *line* 20, *for* fourteenth, *read* ſixth
45, 21, *for* concave lens of a diſperſive fluid, *read* convex lens of a diſperſive fluid
50, 21, *for* then, *read* there

LITERARY CLASS.

Page 6,	*ligne* 25,	commencé,	*liſez* commencée
7,	19,	de,	du
7,	21,	put,	pu
8,	5,	remplis,	remplies
10,	15,	qui,	que
11,	4,	avoit,	avois
11,	17,	lorque,	lorſque
11,	31,	je pu,	j'ai pu
12,	9,	paſſa,	paſſai
12,	14,	architects,	architectes
12,	16,	fut,	fus
12,	21,	détaché,	détachés
12,	24,	ſuivie,	ſuivi
12,	26,	leurs,	leur
13,	17,	n'eſt,	n'eut
14,	4,	ſecond,	ſeconde
14,	6,	de,	des
14,	10,	et,	eſt
22,	4,	quit,	qui
22,	17,	elle,	elles
22,	21,	une,	un
24,	33,	permit,	permets
25,	16,	quoique à,	quoiqu'à
26,	16,	renoncé,	renoncer
27,	8,	je,	je le
27,	20,	s'ecumant,	ecumant
27,	32,	azure,	azuré
28,	21,	mediocre,	mediocres
30,	7,	le longue,	les longs
30,	14,	m'avez,	m'avoit
30,	15,	fois,	foi
34,	1,	d'épreuve,	de preuve
37,	27,	cette,	cet
38,	4,	les princes,	les grands
42,	22,	application,	explication
43,	8,	Grecque,	Greque
49,	8,	deſignée,	deſſinée
50,	2,	put-on,	plut-on
51,	30,	à rien,	à ne rien
54,	23,	à,	de
57,	23,	l'ignoré,	l'ignorer
57,	30,	d'une,	d'un
61,	8,	eſpace,	eſpece
89,	6,	interieurs,	interieures

Page 111. *line* 25. *for* his doing do *read* his doing ſo
113. —— 24. *between* ſaltuum *and* fronteſque *inſert* ſcrutaretur
125. —— 1. *for* prœlio *read* prelio

DIREC-

DIRECTIONS FOR THE BINDER.

The Binder is defired to obferve that the VOL. confifts of Three Sets of Pages, to be arranged in the following order, immediately after the TABLE OF CONTENTS, *viz.* PART I. containing the HISTORY OF THE SOCIETY: PART II. containing, I. PAPERS OF THE PHYSICAL CLASS; II. PAPERS OF THE LITERARY CLASS: And to obferve with refpect to the PLATES as follows, *viz.* that there are in all 24; *viz.* 15 for the PHYSICAL CLASS, and 9 for the LITERARY CLASS: Which are to be placed exactly according to the references marked on the corner of each.

N. B. Five of the Plates have been caft off without the above mentioned references, by omiffion of the Engravers. Place thefe as follows:

Thofe marked { TAB. I. / TAB. II. / TAB. III. / TAB. VI. [for TAB. IV.] } *all to face p.* 264. *Phyf. Cl.*

That entitled—CARTE *de l'ancienne* TROIE, &c. *to face p.* 72. *Lit. Cl.*